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THE MILITARY GEOGRAPHY OF THE TROAD.

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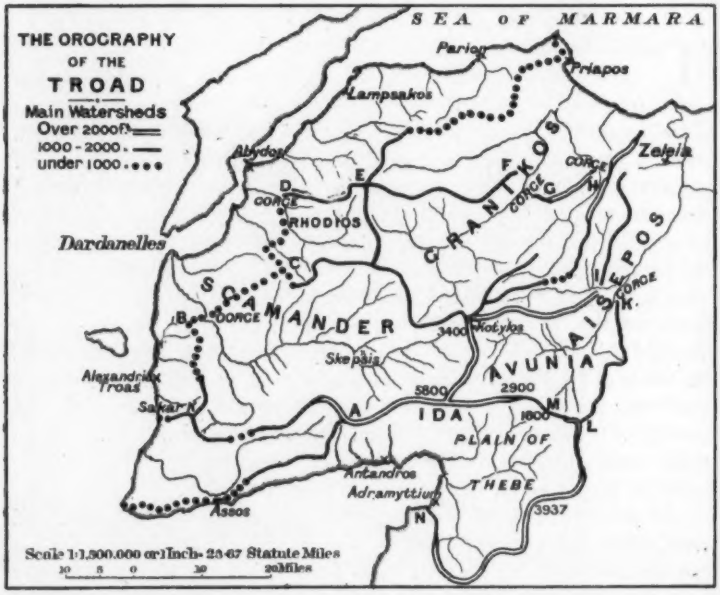
THE north-western bastion of Asia Minor, which is most conveniently called the Troad, though the exact application of that name has varied from time to time, has in all ages possessed an importance entirely out of proportion to its area or its wealth, and due solely to the command which it holds over the waterway of the Hellespont or Dardanelles. Of the vital importance of that waterway to the world it is not at this moment necessary to speak; nor need I say anything of the natural land defences by which it is covered on the European side. My object here is to discuss the natural defences on the other, the Asiatic side; to show that they are even more effective and formidable than on the European coast; and to point out the manner in which geographical conditions controlled and directed the one campaign of firstrate importance which took place within the limits of the Troad. The result will be to show that this rhomboidal land-mass could hardly be better designed as a defence to cover the passage of the Hellespont. It is a well-defined district which can easily be made impassable for any force advancing from the land side with the object of occupying the Asiatic shore of the Dardanelles.

In order to make clearer the somewhat complicated mountain and river system of the district I give a diagram, with a warning that it must not be taken as wholly exact. The fact is that the Troad has never been properly mapped; some not inconsiderable districts have not even been plotted, much less contoured, and I have had to follow isolated heights laid down with more or less authority. But I hope that the errors are not of great magnitude; and for the eastern edge, from the mouth of the Aisepos River to the plain of Adramyttium, which is the most important for our purpose, we have the observations of a distinguished German authority, Dr. Philippson, who has not only travelled over this region, but has contoured the hills lying along the eastern frontier. For the rest I have had to trust mainly to Kiepert's map, corrected in various points by eye observations of my own, supplemented as to heights by the aneroid. For a general map of the district reference may be made to that published in this *Journal* for July 1912.

The first point that will strike us on looking at the diagram is that the Troad is in the main a replica on a very small scale of the mass of Asia Minor, of which it forms a part. Though the proportions are different, the relations of land and sea are very similar. We have the straight southern coast, running almost due east and west, the somewhat shorter western coast running north and south, and the great outward curve of the northern coast, recalling the projection of the coast of Asia Minor into the Black Sea near Sinope. On the east the Troad, like Asia Minor, is connected with a much larger land mass by a wide neck, giving the whole a roughly quadrilateral form.

The mountain structure shows the same analogy. The range of Ida,



the highest in the district, runs, like the high range of Taurus, close to the southern shore, while the important branch which strikes north-eastward from near the highest point corresponds to the range of Antitaurus, running also north-eastwards through Cappadocia. The plain of Thebe in the south-eastern corner, at the head of the Gulf of Adramyttium, recalls the Plain of Tarsus at the head of the Gulf of Issos. And as with Asia Minor, so with the Troad, we can see that the great mass of the interior was once a plateau with a scarp near the shores on the west and north, a system, no doubt, of inland drainage.* In the case of Asia Minor itself

* In the diagram the letters A to I indicate the line of the scarp; K to M the articulation with highlands to the east.

several large inland basins are still left; but in the Troad, with its smaller scale, erosion has been more successful. No internal drainage system now remains; but every main river passes, in the middle or lower part of its course, through a gorge showing where a torrent on the outer scarp has cut its way backwards through the bounding hills and captured the drainage basin in the rear. Generally speaking, the tectonic forces, upheaval and folding, seem to have acted similarly and on parallel lines in the part and in the whole.

Unfortunately I am quite incompetent to speak at first hand of the geology of the district. It is complicated and difficult, and not, I suspect, adequately known. The following outline may however, I think, be taken as correct.

The kernel of the Troad, including all the main ranges, is formed of a mass of metamorphic rocks, limestones and schists. The age of these is to a large extent doubtful; some are said to be Palæozoic, others Mesozoic. But for our purpose the main point is that the chief ranges have been formed long enough to be greatly denuded and degraded. They are all smoothed and rounded in outline; there is hardly a sharp peak or ridge in the whole district. Ida may in fact be taken to be a typical instance of a "stump" mountain.

Subsequent formations are for a long period scantily represented; I need only call attention to a large mass of igneous rock, granite and serpentine, which forms the hills between the site of Alexandria Troas and the Scamander Valley at Ezine.

Overlying these ancient deposits are Tertiary formations, chiefly or entirely, I believe, of the middle or later Miocene. These are most prominent on the western and north-western coasts, where they fringe the sea in an uninterrupted line. Both shores of the Dardanelles are formed of them. From the military point of view they are of the utmost importance; for they guard the whole of this coast, from Lampsakos almost to Cape Baba, with a line of cliffs broken only here and there by short stretches of low coastal plain. The cliffs, formed of clayey or sandy marls, are not indeed precipitous; but they are steep enough to form insurmountable obstacles to landing except at comparatively few points.

These Tertiary cliffs are of paramount importance where they run southwards for a few miles from Kum Kale to Besika Bay. They are sufficient to make any landing impracticable between these two points. And Besika Bay, though a good landing-place, is useless as a base for an advance eastward, for a large marsh bars the way between the shore and the Plain of Troy. Even if this were passed difficulties would only begin. Other marshes lie on the inner flanks of the coast hills; there is the bed of the Scamander itself to be crossed—a serious matter when the stream is full in spring-time. And the whole plain, being alluvial and subject to heavy floods in winter, is seamed by torrent beds running more or less parallel to the main river. These have no stream except in flood-time;

in spring they contain more or less continuous lines of stagnant pools, white with masses of water-ranunculus; in summer they dry up. But at all seasons their vertical clayey banks, generally some 10 feet in height, form natural entrenchments which would have to be forced; and when it is added that the heights on the eastern edge of the plain are sufficient to give a very fair command, it will be clear that any attack on the Dardanelles defences from this western shore would meet the most formidable obstacles from the very first step; and it is no matter of surprise that the difficulties of the European shore, insurmountable though they have proved to be, should have been chosen in preference to them. If the Plain of Troy is to be the point of attack it must be approached as it was approached by Agamemnon and his army three thousand years ago—by a landing on the north coast, within the mouth of the Straits, where the advance will be parallel to the torrent-beds, not across them. We can therefore see the reasons for the choice of the European shore rather than the Asiatic in the recent landing; nothing could be done on the south till full command of the landing-place was obtained by holding the coast to the north.

Intricately mingled with these Tertiary deposits are found large masses of eruptive rocks, the results of several great volcanic outflows which have profoundly modified the face of the land. They consist mainly of andesite or trachyte, with conglomerates of volcanic *débris*, and here and there dykes of basalt. The series of eruptions began during the Miocene period; the last and greatest outflow may have taken place immediately after the close of it. There are two great areas of these volcanic rocks. The first is bounded on the east and south by the main stream of the Granikos and the hills on the north of the Scamander Valley; it extends almost to the Straits, being cut off from them only by the narrow belt of Tertiary deposits, behind which it reaches nearly as far as Lampsakos. Its northern boundary runs a little south of east from Lampsakos to the junction of the Granikos with its western affluent the Kara Atli Su. It is mostly an arid plateau, hardly inhabited except by nomads and their flocks, and has been rarely visited by travellers. It rises in two hills to a considerable height—the Tavshan Tepe is credited with 2493 feet and the Shab Dagh with 3000—but for the greater part of its extent it seems to be a rolling upland country, featureless and scrub-covered.

The second, and so far as the structure of the country is concerned, the more important volcanic outflow is that which covers the south-western corner of the peninsula. A great dyke, mainly of andesite, fringes the southern coast eastwards from Cape Baba till it abuts against the main mass of Mount Ida. It presents to the sea for several miles a line of high and generally precipitous cliffs, forbidding landing at their foot or passage across them. Near Cape Baba it rises to 1600 feet in height. It then extends in a lower plateau of considerable width, gradually falling and narrowing till at one point it becomes a narrow neck only 400 feet

RIVER GRANIKOS, PROBABLE SITE OF ALEXANDER'S VICTORY.

PLAIN OF GRANIKOS, LOOKING TOWARDS BIGHA.

THE GORGE OF THE SCAMANDER FROM BALLY DAGH (LOOKING SOUTH).

SAKAR KAYA FROM NORTH. DECIDUOUS FOREST OF VALONEA OAK, CONTINENTAL CLIMATE. (Fig. 1.)

SAKAR KAYA FROM SOUTH. SCRUB OF VALONEA OAK, CONTINENTAL-MEDITERRANEAN CLIMATE. (Fig. 2.)

SATNIOIS VALLEY FROM ANDESITE COAST RANGE. HILL OF BEHRAM (ANCIENT ASSOS) IN DISTANCE. (Fig. 3.)

above the sea. Here is the easiest passage, and hence a comparatively easy road leads across the main range of Ida into the central plain of the Troad, the middle valley of the Scamander. This point has therefore been of considerable commercial and strategic importance. The neck is commanded by a volcanic cone rising to well over 700 feet; and on this stood in ancient times the city of Assos, which grew rich by its control of the trade between the fertile Scamander plain and all the wealthy cities of the coast to the south. The cliffs descend precipitously to the sea, and offer no natural facilities for landing; but the other advantages of the spot are such that it has always been worth while to maintain a mole forming an artificial harbour, and a path for horse traffic up their face and across the neck; and though Assos is now represented only by the wretched village of Behram, the mole is still maintained in good condition, and shelters a not inconsiderable coasting traffic.

This southern dyke has also had a marked influence on the structure of the country. It has formed a valley south of the main watershed, which collects all the streams from the north and carries them away from their natural course into the nearest sea, discharging them on the western coast. The river which flows along the valley has thus a very unusual course. It rises near the sea, and flows entirely parallel to it. At the neck of Assos it is barely a mile from the sea, though 300 feet above it; but it has to wander some 20 miles before it finds an outlet, passing on the way through a narrow erosion gorge which it has cut for itself.

We must pass on, however, from these secondary ranges, the fringe of the Troad and of the subject, and consider more closely the essential structure, the main skeleton of the district.

The central portion, it will be seen, is divided between three river basins, those of the Scamander, the Granikos, and the Aisepos—the smaller basin of the Rhodios may be left out of sight for the moment. The orographic centre of the country, in the sense of the point where these three river systems meet, is at a place which was called in ancient days Kotylos, but has no particular modern name, as far as I know, except that it is near a spring known as Hajji-öldüren. Except as an abstraction this centre has no importance in fact. It is not a peak at all, but a mere angle in a ridge. The dominant feature alike in the landscape and in the structure of the Troad is the high range of Ida, running nearly west and east from the Sakar Kaya on the western coast to beyond the head of the Gulf of Adramyttium.

The western extremity of the main range, the Sakar Kaya, is a well-marked peak, forming one of the chief landmarks of the whole Troad. We must dwell for a moment upon it, for it does not on the maps, or indeed in the narratives of travellers, show its real importance. So far as I am aware its height has never been measured; I should guess it to be somewhere between 1500 and 2000 feet. Nor is even its formation certain; for while Diller speaks of it as limestone, Philippson's geological

map includes it in the mass of granite lying to the north. But whatever its formation and whatever its height, it plays an important part, not merely as a conspicuous feature in the landscape, but as a boundary between two climates.

The "Mediterranean" climate, the climate of moist mild winters and almost rainless summers, does not, of course, extend to the northern part of the Mediterranean Sea; the latitude of 40° is generally taken as roughly marking the line where it comes into contact with the "Continental" climate of Europe. Now this line of latitude runs through the Troad only a few miles north of the Sakar Kaya, so that we should anyhow expect to find signs of the transition in this neighbourhood. But this rather high ridge, running east and west right across the region of very pronounced northerly winds—the Etesians of the Greeks, or the Continental "Trade winds"—emphasizes the transition in a very instructive manner. Its height is evidently enough to drain the northerly winds of summer of the last of their moisture as they pass over it; and the result is plainly shown by the change of vegetation.

All the coastal plain, for many miles to the north of Sakar Kaya, is covered by a forest of the deciduous valonea oak, the acorn cups of which, valuable for tanning and dyeing, are the chief export of the district. Such a scattered open forest, almost like a well-planted English park, may be taken as evidence of sufficient summer rain. In other words we are still within the influence of the Continental climate of the north (see Fig. 1).

But no sooner have we rounded the foot of the ridge by which the Sakar Kaya falls right to the seashore than the vegetation changes. The deciduous oak still persists for a time, but no longer as a forest tree. It is reduced to thick and low scrub, covering the ground with a close mantle, to preserve as far as may be from evaporation what little moisture the soil may have. In other words the summer rainfall has been greatly reduced in amount (Fig. 2).

Only a little further south the oak-scrub completely disappears, and we find ourselves in the midst of vegetation formed to resist the long and almost complete summer drought of the Mediterranean climate—the thorny, aromatic, glaucous "maquis" with the gums which enable it to conserve to the utmost the precious moisture against evaporation. The change is in itself a familiar one, but there can be few places where it can be followed so completely within so short a distance (Fig. 3).

Only a little further east the conditions are materially modified by the great mass of the Ida range, which accumulates deep snow in the winter, and deals it out through the summer by its numerous fountains. No wonder that Gargara on its flanks was proverbial in antiquity for its fabulous fertility. It enjoys the blessings of two climates—the moist and warm winter, and the summer sun of the south, with abundant subsoil water all the year round; so that irrigation, on a friable volcanic soil, was capable of producing the repeated crops at the abundance of which, as

Virgil tells us, Gargara itself stood amazed. Even under the conditions of modern Turkish rule the southern slopes of Ida are covered with extensive olive groves which bring in substantial wealth to their owners.

But I am afraid that we have to discuss the skeleton of the Troad, and must resist the temptation to clothe it with flesh. So I must apologize for this digression, and return to the dry bones.

To the east of the Sakar Kaya the main watershed is not well marked; but it appears to maintain a height of over 1000 feet, except for a short distance where the town of Aivajik stands on a saddle of slightly less elevation. This saddle forms the natural and easy outlet to the south for the central plain of the Scamander, which can thus reach the sea by the neck at Assos of which I have already spoken. East of this again the hills run pretty steadily upwards to the summit of Ida, a large plateau at a height of about 5800 feet, and then again fall, maintaining the same general direction as far as the point marked L, where this ridge articulates with another running generally north-north-east to south-south-west till it curves round to enclose the rich alluvial plain of Thebe or Adramyttium.

From near the summit of Ida a branch is sent off to the point called Kotylos, where it forks and runs in a double line, first in an easterly and then in a north-north-easterly line till it falls rapidly a little before reaching the sea by the mouth of the Aisepos.

This is only the spine of the skeleton; but we see at once how defensible it makes the whole Troad against any approach from the east or south. The mere height of the central part, where it runs up to over 5000 feet, is in itself a formidable barrier; and where it is lower, the barrier is doubled—in the west by the precipitous sea-cliffs of the volcanic range, and on the south-east by the bifurcation of the main ridge. On the south it is impossible to turn the mountains in any way; the southern spurs of Ida run right down to the water, and the coast road at one point, the ancient Antandros, has actually to pass over the sand and pebbles of the beach. On the north, however, there is a weak spot. Where the north-eastern ridge falls below the 2000-feet limit there is no redoubling of the line. Here the hills on the further side drop to a great and level plain on the east, while on the west they fall by gentle undulations to the smaller but almost equally easy lower plain of the Granikos.

Now let us turn from the spine to what we may call the ribs—the almost continuous chain of hills which, as I have already suggested, form the edge of an ancient central plateau, and have been in several places cut through by the erosion gorges.

Such gorges, if cut through hard rocks, do not always offer a convenient path; and it often happens that a line of defence is not seriously affected by such a breach in the line. This is eminently the case with the most important of the gorges of the Troad, that which cuts off the central basin of the Scamander from the Trojan plain (marked B in the diagram). The valley bed is here quite impassable, especially at its

northern end, where the limestone cliffs are the boldest and ruggedest of the Troad. The carriage-road from Ezine to Chanak—the only good road in the Troad—goes right across the hills to the east; a horse-track passes over the western range, and goes for some distance down the central part of the ravine, only to rise again to a considerable height before reaching Ezine. The sides of the ravine at its southern end are less rugged in outline, as the rocks are no longer of hard limestone, but of the softer serpentine. But for all purposes, whether for ordinary or military traffic, the hills form a barrier none the less for the cleft which passes through them.

This is not true in quite the same degree of the second important passage, that from the upper basin of the Granikos to the plain below (see F–G in diagram). That is, in fact, a defile rather than a gorge. The bed of the river marks the boundary of the volcanic plateau on the west and the metamorphic rocks on the east; and the softer nature of the eruptive rocks softens the contour of the hills on the left bank, so that there is just room, and no more, on this side for a rough and narrow carriage-road. In general it may be said that communication in the north-east to south-west direction is comparatively easy through all the central Troad. This, of course, means, in military terms, that parallel to and in the rear of the main lines of defence of the eastern frontier is good communication all along the line—a very important consideration.

Of the eastern edge of the plateau I cannot speak from personal knowledge, but the facts recorded by Philippson in his map seem decisive. There is an unmistakable erosion gorge (K) in the middle course of the Aisepos River; it is deep and narrow, and the path northwards does not traverse it, but goes high over the hills at the side. Close to the upper end of it there is another erosion gorge (I) entering laterally, which has penetrated some distance into territory properly belonging to the Granikos system, and filched a considerable area. Of this last district I can find no description; I am not aware that any European traveller has traversed, or even seen, the gorge; and the area to the west of it is unmapped. Tchihatcheff once passed through it, but never published his journey, and the only record of it is found in some scanty notes of his, discovered and deciphered by H. Kiepert and printed in *Petermanns Mitteilungen*. Subject, however, to further information, I feel confident that this apparent breach in the range is not practicable, at least for military purposes; and that if it were desired to bring an army into the eastern portion of the Granikos system, this is not the route that would commend itself.

The fact is that the natural outlet of the very secluded upper valley of the Aisepos, which is known by the name of Avunia, is not northwards down the course of the river at all, but southwards over the hills at an easy pass marked M. Here the sea is nearest; and in antiquity it was to the market of Adramyttium that the merchants of Avunia brought their produce,

the most valuable of which was silver, mined in the southern part of the district, where the tailings and shafts of the old workings are still to be seen. The pass at M is only just over Philippson's 500-metre contour line, while that running northwards reaches a height of 447 metres, so that in height there is nothing to choose between the two, and the shorter distance brings Avunia decisively southwards. It was by Adramyttium and over this pass and then straight across the range on the northern side of Avunia that the ancient military road ran from Pergamon to the Sea of Marmara.

Let us now pass on to consider how far these geographical considerations will enable us to understand the most famous campaign which was ever, at least in historical times, carried on within the Troad itself. I speak, of course, of the campaign of the year 334 B.C., when Alexander began his amazing career of Eastern conquest, and, invading Asia from Europe, crushed the Persian army on the banks of the Granikos, winning by a single blow the greater and most valuable part of Asia Minor.

When Alexander planned that campaign he had not command of the sea. His fleet consisted, apparently, of about 120 warships, against which the Persians could have set the Phœnician fleet of 400. But though they thus had the potential command they did not exercise it; the fleet was not mobilized till too late. On such unpardonable blindness Alexander could hardly count; it would have been inconceivably rash to attempt invasion by sea with such an overwhelming fleet in being. He was therefore compelled to invade by land, using his smaller fleet to cover the one short passage, that of the Hellespont, where paucity of numbers would be compensated by the narrowness of the front on which alone the enemy could attack. This was clearly the least risk he could take, and the plan was wholly successful. No opposition was made to his passage; the Phœnician fleet remained at home, while the Persian army awaited his coming at a considerable distance away. The headquarters of the enemy were in fact fixed at the little town of Zeleia, on the extreme eastern border where the hill country of the Troad ends on the lower course of the Aisepos. Here the character of the country entirely changes, and the low fertile plain of Daskylion stretches eastward for many miles without a break. The choice of this as the strategic centre is amply explained by the conditions; it was the best that could be selected when once the proper scheme of defence of the passage by the fleet had been abandoned.

The north-western coast-line is the most vulnerable point of the whole Troad against attack from the west; but in order that it may be pierced, the assailant must not only hold the whole peninsula of Gallipoli—he must further be in a position to bring ships for transport to any point which he may choose. Alexander found himself in that position, and the problem was easy for him in consequence. Whether under modern conditions the mere possession of the peninsula would involve as a corollary such command of the Asiatic shore as to make it untenable for defenders

is a problem which is of too technical a nature for me to answer. If it were possible to get astride the Straits at the northern end, and hold both Gallipoli and Lapsaki, no doubt the question would be satisfactorily solved. But I ask myself how it would be possible, holding one shore only, to bring boats or ships up to Gallipoli for a crossing there? If that were not practicable, the alternative would be to hold such command of the lower end as to effect landings on the Scamander delta, and if possible in the bay to the north of Eren-kiöi, and so turn the defence of Chanak and the formidable forts on the Narrows from the east. But I cannot imagine that any commander would look forward with great confidence to such a campaign, nor was I ever able to share the general view that if the Gallipoli Peninsula were once won the work was practically over.

The Persians in 334 had taken no steps either to hold the outwork, the Peninsula, or to dispute the passage by their ships. It might be thought that they should still have posted their army along the European shore in order to oppose a landing. But it is easy to see why they did not do this.

The Asiatic shore of the Hellespont is a long line to cover, some 35 miles; it has numerous landing-places; the higher and steeper European shore gives every facility for the massing of troops out of sight at any point of the peninsula. And the only good line of communication between the two extremities runs all the way quite close to the shore, and may be cut at almost any point by a sudden landing. The whole length of the narrow coastal plain, from Lampsakos in the north to the plain of Troy in the south, is backed by ridges of hills at a distance varying from less than a mile to three or four—sometimes indeed running right into the sea. This is the outer scarp of the central plateau.

It is at certain points eaten into by encroaching torrents, which have cut their way more or less deeply into the plateau. One of them, the ancient Rhodios, which enters the straits at the modern town of Chanak, has already filched a quite respectable upper basin; from this it enters the coastal plain through an erosion gorge (D) of the usual character. This gorge was the scene of one of the exploits of the Athenian general Iphikrates. Here he caught in an ambush a Spartan force as it was descending—so Xenophon explicitly tells us—from the plateau, and annihilated it. This is, of course, not the sort of ground which a general would care to have immediately in the rear of the centre of a long line of defence. And even when the scarp is mounted, the plateau country behind it is not much better. It is easy enough to march across; but it is at the present day bare and unpeopled, unless by the nomad tribes and their flocks. It is poorly watered, and has probably been deserted at all times; there is not a single village name in it known from ancient times. It could supply no resources of its own, and kept at a great distance any town which could possibly serve as a supply base. In short, the whole country in the rear of the centre makes the position of an army posted on the Asiatic shore of the straits to resist a crossing absolutely untenable, and we need not

wonder that neither the Persian commander nor any other before or since has ventured to undertake such a dangerous task.

On the flanks, indeed, the conditions are better. At the south western end there is a passage across the hills, steep in parts, but presenting no serious difficulty, and leading straight into the fertile centre plain of the Scamander. This is, for purposes of merely internal communication, the most important route in the Troad; it is followed by the only good carriage-road of modern days, that leading from Chanak to Ezine. But it has no exit to the east; it leads straight up to the high range of Central Ida, and the only easy way out of it is to the north, into the upper valley of the Granikos, whence the lower plain can be reached only through a defile.

There remains the northern flank. The modern road from Chanak to Bigha in the Granikos Valley follows for half the way the coast of the Sea of Marmara. This is at first flat and easy; but a short distance east of the site of the ancient Paisos the hills come down to the sea; they are cut up at short intervals by steep-sided gullies, and at one point, where it passes Boz Burnu, the track is actually driven into the waves of the sea for a short distance. Even where, east of this, it turns inland, the track—for there is no road—is excessively rough. In short, this is not a comfortable road for an army in the face of an enemy.

There is, however, an alternative. Just east of Lampsakos, by a steep but short ascent, it is possible to gain the plateau at a point whence there is a gradual and easy descent leading straight down to the lower plain of the Granikos. This line is marked by the course of two streams, the Kara Atli Chai and its northern neighbour the Pomak Chai or Kemer Su. These two are the only considerable watercourses of the Troad which lie outside the central plateau, and consequently the only two, so far as I am aware, which pass in their whole course through no ravines of importance. Save for the one steep slope above Lampsakos, there is easy going along all this line. Nor was the valley devoid of population in ancient times; we hear of one town in it, and learn moreover from Strabo that it contained excellent vineyards.

From within a few miles of Lampsakos, then, to the Granikos Plain, and right across it to the hills on its eastern border, there is good marching country for an army. There is no such long stretch anywhere else in the Troad. For the defence of the Hellespont it is of little service. It is on the extreme right flank of an army drawn up to defend the long shore, and for that purpose is clearly worthless. Nor do the hills above Lampsakos offer a favourable defensive position, for they can be turned on either side, best perhaps through the Scamander Valley on the south. But for an army marching eastwards from the Straits it is clearly marked out as the one possible line of advance, for it leads straight to the only weak point in the range of Ida—the point where, as I have already said, the hills fall rapidly to the Sea of Marmara, and offer an easy passage either across their lower passes, or on the level by the seashore at their northern end.

We can see then why it was that the Persian army chose the insignificant little town of Zeleia for their headquarters. It is situated in exactly the right place for the defence of the one weak point in the natural frontier of the Troad. It covered each of the two roads by which alone the army of Alexander could cross the hills lying between him and the plains of Asia Minor. His route could be predicted with absolute certainty. It must be remembered that he relied for victory on the famous Macedonian Phalanx. This was a formation which for long proved invincible in the plains, but it depended on attack in the most solid formation; on broken ground it was unwieldy and inflexible. Above all, it was wholly unsuited for forest fighting; and the great pine woods which clothe all the higher slopes of Ida would prove a more formidable obstacle to Alexander even than their steepness and height. For him all the southern part of the range was impassable, and even if, by a miracle, he should attempt it, it could easily be reached from Zeleia in time for defence.

Zeleia had, in addition, the advantage of abundant supplies. The plain of Daskylion, on the western edge of which the town lay, was famous for its wealth in all sorts of produce; on this very ground it was the favourite residence of the Persian satraps of the district, who possessed great parks for hunting, and disposed of vast private revenues from their rents. And hardly 20 miles in their rear was the port and market of the great city of Kyzikos.

We see then that Zeleia was, from a purely military point of view, the best strategic position possible; and the Persians were quite right in awaiting Alexander here. Their great mistake was that they never had any conception of the power which their fleet gave them. Memnon, the commander of the Greek mercenaries who formed the best part of their infantry, urged that they should retire, luring Alexander on and clearing the country behind them of supplies, while at the same time making an attack by sea on the heart of the Macedonian power in Macedonia itself. That policy could have hardly failed to foil Alexander. But the Persians were no sailors; they were inland people with no fleet of their own, and had to depend on their Phœnician subjects, whom they probably mistrusted; and it must be added that their experience of two invasions in the preceding century, under Darius and Xerxes, had not resulted in a way to cure them of their natural distaste for salt water. Salamis and Marathon were not encouraging precedents.

Alexander judged his enemy rightly, and took the risk. He marched by the coast road to the Hellespont; but instead of going straight to Lampsakos, which he was bound to pass, he took his army across at the Narrows—from Sestos to Abydos. This involved a *détour* of some 40 miles—20 miles down the peninsula of Gallipoli to Sestos, and an equal distance along the Asiatic shore back to Lampsakos. Why he should have made this *détour* is not told us. There is, so far as I can see, no geographical or military reason for it. The crossing at Lampsakos

is just as easy as at Abydos; the fact that it is perhaps half a mile longer makes no real difference, and time was certainly of the greatest importance. The reason must have been political. We are told that Alexander was once much enraged with Lampsakos, and threatened to destroy the town. The statement is not in the historians, but comes in an independent anecdote; but Alexander was never at Lampsakos at any other time, and I have little doubt that Lampsakos, a rich commercial town, refused him permission to cross in their territory. The smaller town of Abydos was more amenable, and Alexander thought it better to go out of his way rather than fight for the crossing, especially as he was posing as leader of Hellenism against barbarism, and it was not his policy to begin his campaign with a war on a Greek city.

There is one other small apparent difficulty in Alexander's march which deserves short mention because it illustrates the nature of the country. Arrian says that Alexander, after leaving Lampsakos, camped on the river Praktios. Now there is no doubt that the river Praktios is identical with the Bergaz Chai, which runs between Lampsakos and Abydos. Alexander had therefore crossed it before reaching Lampsakos. How does it happen that he encamps upon it again after leaving Lampsakos?

A satisfactory answer has been given to this question by a German officer, Colonel Janke, who some years ago went over the ground in studying the campaign from a military point of view. He followed the valley of the Bergaz Chai directly upwards from its mouth, though told on the spot that there was no way. He reports that the valley is wholly impassable for an army. He found himself entangled, on hills overhanging the river, in a maze of steep-sided ravines, covered with dense and thorny brushwood, running down to the narrow gorge through which the water forces its way. The river passes, in fact, by a typical erosion gorge through the scarp of the main plateau. Once this difficult pass was left behind, the way grew easy. The upper basin lies in the undulating ground of the plateau. And this can be reached direct from Lampsakos by a path which is said to be easy. I have not traversed it myself, nor can I find any description of it. I can only say that, as seen from Lampsakos, there appeared to be an open and nearly level valley running right to the foot of the hills; and that, if the maps are to be trusted, a single short but steep ascent leads directly to the plateau on the east. This was clearly the path taken by Alexander, and it is right to say that after leaving Lampsakos he encamped on the Praktios—that is to say, on the upper basin which the river had captured from the plateau.

From this point Alexander marched at full speed straight for the lower Granikos, whither the Persian army marched also, to dispute his passage of the river—again a proper move, as here they covered both the alternative routes by which the Macedonians could proceed, by the coast road or straight over the hills. There is a little uncertainty as to his exact road; for there is now a wide but shallow and reedy lake, the Eje Göl,

not mentioned in the accounts of the battle, and one cannot be sure if he passed over the site of it, or went round to the south or the north. But in any case the actual battle must have been fought just north of the confluence of the Granikos and its western affluent, the Kara-atli Su, a stream hardly less in size.

The plain here is almost treeless and very level. The river flows through the alluvial soil in a trench which is practically invisible at a short distance; its banks are about 10 feet high, mostly vertical, and clothed with dense undergrowth. It makes a formidable obstacle to the passage of an army against active opposition. It is said that when Alexander inspected it before the battle his chief of the staff, Parmenio, was so much impressed by the difficulty that he urged the king to postpone the attempt till next day. Alexander replied in effect that, after crossing the Hellespont, he was not going to be stopped by a ditch, and gave orders for the attack to be made at once.

There have been bridges over the river at this point at various times—there is one now, and the name of the village which stands here, Chinar Köprü, Plane-tree Bridge, indicates the natural crossing-place of the main stream, just below the mouth of the lowest large affluent. But no bridge is mentioned in the account of the battle, and it is likely that none existed then. This implies a ford, and a ford implies a drift, a breach in the banks. At least one such exists to-day, in spite of the bridge hardly a quarter of a mile off. It is likely that there may have been more than one such, and that it was at these points that the army of Alexander won its footing on the right bank. The attack was made, however, all along the line, and though repulsed at first at several points, the end was that the whole army forced the passage, and the Persian force was simply annihilated. The first great step in Alexander's career of victory had been won.

This digression into the history of an ancient campaign has been a long one, but I have not hesitated to work it out, because it brings before us, I believe, the essential conditions which must govern any campaign by land in the Troad, whether the aim is to make the Hellespont either the base of an army advancing from the west or the object of an army advancing from the east. It remains as true now as it was in 334 B.C. that the one easy line of advance in either direction lies between the hills lying above Lampsakos and the hills lying above Zeleia—Sari-keui, as it is now named. An army holding the Troad for defensive purposes is protected, except at this one point, by a natural frontier which may for practical purposes be regarded as impregnable—a double or triple line of high, rough, steep, and forest-clad hills or else of barren and scrub-covered highlands. But the line where strong military defence would be needed, at the extreme north, is curiously short.

That the line of hills running due southward from the gorge of the Aisepos and encircling the Plain of Thebe forms a natural frontier, and that Avunia consequently belongs rather to the south than to the valley

of the Aisepos at the north, has already been pointed out. Whether it would be chosen as the military frontier is another question on which I do not feel able to speak with assurance. In the first place I have not seen it. In the second place, political questions would probably be involved, the conditions of which we do not know. It might be held that the possession of the Plain of Thebe, with Edremid, its chief town, was of great importance for the defence; it might be that the holding of it would entail risks not commensurate with the advantages. But that the main ridge of Ida, from the heights above Antandros to Kotylos and then eastwards to the gorge, would form an impenetrable line of defence I feel no doubt.

It is true that this main range was once crossed at its very centre by a great army—great even on the scale of the present day, if the figures handed down are to be believed; for Xerxes, when he invaded Greece in 480 B.C. took with him an army of a million men, and he went, as Herodotus tells us, from the Plain of Thebe to the Scamander Valley, "keeping Ida on his left." This leaves no room for doubt as to his exact road. There is only one pass which leads in the required direction. It passes nearly under the top of Ida, at a height of over 4500 feet. Apart from the mere labour involved in reaching this height in a distance of only some 8 miles from sea-level, the pass offers no particular difficulty either to a pedestrian or a pack-horse; there is a quite fair track all the way, and it is used constantly for bringing pine-planks down from the heights. At one point the passage has been improved by a cutting through a barrier of limestone which runs across the path. This cutting may well have been made to facilitate the movement of Xerxes' army; it must have been made for the sake of wheeled traffic; and the path, though certainly now not passable by wheels, could be made so by a sufficient expenditure of labour.

But though an army might thus cross it if everything were in its favour, it could not force the way against armed resistance. The passage in many places could only be made in single file along hillsides so steep that there is little choice of road, and the advantages of the defence would be overwhelming. Another faintly marked track leads over the crest just south of Kotylos from Avunia into the southern extremity of the Granikos basin, and another, I believe—I have not seen it—into the eastern part of the same basin across the less lofty part of the hills which bound Avunia on the north. But I do not believe that any of these could be forced by an army against any organized resistance.

And behind all this strong line of hills communication is easy. Of the passes which lead northwards from the main Scamander Valley I have already spoken. Just west of Kotylos the hills fall from a height of over 3500 feet to less than 1400; a col with scarcely any perceptible rise leads here from the extreme upper valley of the Scamander through the district called Kizil Elma, "Red Apple," to the rear of the northern boundary of Avunia, so that a small force could act equally well on either side.

And even if by some miracle either of the passes here were forced, a defending army has positions in the rear to fall back upon, always in easy contact with its bases on the Hellespont.

So it is that Nature has not only made in the Dardanelles one of the great and vital highways of humanity, where from time to time the struggles of nations find their strategic and political focus; but she has fenced it about on either side with fortresses of hills, so as to make it nearly impregnable by land on either side.

The PRESIDENT: Dr. Walter Leaf, who is to address us to-night, has, if he will excuse my saying so, a double personality. In the City he is well known as a high financial authority; in the outer world and in the literary world we recognize him as a scholar and as a translator of Homer. Here, I may add, we greet him also as a traveller and an Alpine climber. He is President of the Hellenic Society, and a former Vice-President of the Alpine Club. He has also contributed papers to our *Journal*. In the course of his Homeric studies he has naturally been led to explore the scene of the Trojan War, and it is on that he is going to speak to us to-night. He will point out its physical characteristics and their bearing on military history and strategy. We need not fear that any information he gives us will be of value to the enemy; for I notice that the authorities he cites are mostly German maps and German writers. He may, however, possibly bring to our notice facts which have hitherto been imperfectly appreciated by our own authorities. It is one of the very few consolations of the war that for the first time travellers are welcomed with an altogether new and unprecedented enthusiasm in Government Offices; so much, indeed, are they appreciated that some of our Government Offices wish to keep our travellers' tales entirely to themselves! With this preamble, I will ask Dr. Leaf to read his paper.

(*Dr. Leaf then read the paper printed above and a discussion followed.*)

The PRESIDENT: We are unlucky in not being able to hear Sir William Ramsay this evening, and Mr. Hogarth, another high authority on the Near East, has been captured by the Admiralty, put into a Commander's uniform, and sent somewhere east of Aden. But we have here one who is an almost universal authority, Lord Bryce. He will, I am sure, be able to add something of interest with regard both to the geography and the history involved in the lecture to which we have listened.

Lord BRYCE: I cannot but think that there must be many here who are much more competent to speak on this paper than I can be, for my knowledge is somewhat remote in time and limited in extent; but I am sure there is no one who can express more heartily his admiration for the exceeding lucidity and accuracy of statement with which Dr. Leaf has brought before us the natural features of this district and has explained how those natural features are related not only to the military position in the time of Xerxes and afterwards of Alexander, more than twenty centuries ago, but also to the situation which confronted our naval and military authorities when they planned an expedition to pass the Dardanelles and open a passage from the Ægean to the Sea of Marmora and the Euxine. Those of you who read an extremely interesting article by Dr. Leaf, which has appeared during the last eight months in one of the magazines, will know how very fertile in events of historical importance the whole of that region has been. My recollections of the Athenian and Spartan

operations are, after nearly sixty years, growing rather dim. Dr. Leaf has not entered upon those military operations with which most of us are much more familiar, those which were executed under the command of Agamemnon during the siege of Troy. He has, however, dealt with the military situation of our own day. I gather from him that he thinks that bad as the choice proved to be of attempting to take the Dardanelles either wholly by sea or wholly by land, it would have been a distinct error to attempt land operations upon the Asiatic side owing to the character of the coast, and certainly it would have been necessary, according to him, for an army to have passed by a difficult road which would have been exposed to the enemy's fire from the European shore. I should like to ask whether it would be possible to land and attempt to move northwards over the Adramyttium Plain, to force the comparatively easy passes at its extremity and descend from them into the basin of the Lower Aisepos, then descend north-westwards from the heights above the Propontis and in that way move down to the Straits. It may be that there is something as nearly approaching a road as you ever find in the Turkish dominions leading from Adramyttium in that direction. I should be glad if Dr. Leaf would tell us what he thinks of the prospects of any operations along such a line. I can only offer a very small contribution to what Dr. Leaf has said about the geology of the district. I have been in that region twice, and on both occasions I was so hampered by want of time that I found it impossible to make the ascent of Ida. I do remember, however, to have gone from Troy—and this is a great many years ago—from the place which is now recognized as the true Homeric Troy, that is, Hissarlik in the maritime plain, up to what had been long (and was still by a few persons) deemed to be the rival site of Bunar Bashi which is several miles southward in the interior. This was in 1880. There had long been a school which held out for Bunar Bashi as the real Troy, but any one who visited the place could see it could not possibly be the Troy described in the 'Iliad,' because its situation is absolutely inconsistent with the story that Achilles chased Hector round the walls of the city and subsequently dragged his corpse round. The local conditions make that impossible. This hill is composed of limestone and the strata seemed to be of an earlier geological period than the Tertiary. Perhaps, however, the German authorities whom Dr. Leaf has cited may throw a little light on that question. In passing, one may say that it is strange that all these topographical investigations and all the books which record the results should have been compiled by Germans and, apparently, none by British officers. I had in 1880, however, had the advantage of visiting the Troad with a British officer who was a very competent archæologist, the late General Sir Charles Wilson, and I know he intended making a careful examination of the whole district. Whether he ever did so, I cannot say; but, at any rate, if he did I presume it was not in any way so complete and exhaustive as those of the authorities whom Dr. Leaf has cited. I should like to ask Dr. Leaf if he has any ground for supposing that the plain of the river Granikos was covered by scrub in the days of Alexander's march, as it now appears in the photographs which he showed. If the scrub added to the difficulty of the narrow track through the hills and across the river-bed which Alexander appears to have followed, after moving inland, would it not have opposed serious obstacles to the operations of the Macedonian Phalanx? The phalanx required plenty of space and level ground clear of trees. It is possible, however, that in those days, when better government than that of the Turks prevailed, the plain may have been more cultivated and more free from scrub than perhaps it is now, so that it was easier to traverse. Dr. Leaf having had the advantage of

examining the site may possibly be kind enough to give us the information. I can only, in conclusion, say what very great pleasure I have had in listening to the admirable exposition of the topography of the region presented in the paper.

Mr. THACHER CLARKE (Head of American Archæological Expedition to Assos): I am afraid that the problem of the invasion of the Southern Troad is one of such entire impossibility that my experience, which is almost entirely restricted to that district, can only confirm what has already been said. With reference to the question asked by Lord Bryce concerning the access to the Sea of Marmara from the Plain of Adramyttium, I have been over the pass at the headwaters of the river, and that pass in itself presents no great difficulty; but those who to-day live in that inner country find their natural way to the sea always by the south and never by the north, and the gorge through which the river goes is understood to be almost impassable. I fancy the difficulties would not be found in the pass but in the further course of the river. Dr. Leaf shows that the only traveller who has ever visited that gorge is Tchihatcheff, who did not publish any account of his journey, but left certain notes which were examined by Dr. Kiepert, and I think these bear out his contention that the country around the headwaters of the River Aisepos always found its outlet to the south. Hence that argument will reinforce the suggestion that the difficulty of that way would be far greater than that of the pass itself.

Prof. CALDER: I am glad for one reason that I have been called upon to speak, and that is because it gives me an opportunity of thanking Dr. Leaf for the most illuminating and almost compelling change of view which his paper introduces into one's thinking about the Troad. From the time of Agamemnon till now one has always thought of the guns of the Troad, as it were, pointing westward; but to-night he has been pointing them east. That idea with regard to the Troad itself, as well as to Asia Minor, is a very fruitful conception; whether it will ever materialize into a fact depends upon a large number of considerations, not military. But Dr. Leaf's parallel between the military geography of the Troad and that of the whole of Asia Minor is, I think, extraordinarily interesting from the point of view of what is happening in the east of Asia Minor. As he says, Asia Minor and the Troad are bounded in the south by a practically impassable ridge. From the eastern part of that ridge runs another ridge north-east; it runs north-east in both cases, but in Asia Minor, after running north-east, it turns east again. Imagine what would happen, supposing a force were holding the Troad from the west, with the guns pointing eastward; imagine what would happen if an enemy got across that ridge and landed somewhere near Cyzicus as well as east of Cyzicus and came sweeping down both sides of the ridge. That is precisely what is happening at the present time in the eastern portion of Asia Minor. You have got the Russians at Erzerum, and the Russians and British further south. Imagine a Russian advance from somewhere in the north-east towards the plain of Thebe. Then imagine a British force landing at Thebe and trying at the same time to press across from Thebe by the same path by which Xerxes crossed the Troad. The parallel between the two cases is very instructive. The whole question of the military history of Asia Minor, not only of the Troad but of the whole of Asia Minor, has a very interesting bearing indeed on the possibility of military operations there now. Practically the whole of what we know of the geography of inner Asia Minor has been gathered by archæologists who have travelled mostly along ancient trade and military routes. A vast amount of information has been collected about these routes, and while many things from a practical point of view have changed as between the possibilities

of advances in ancient times and those at present, there is one fact that has not changed, and that is the possibility of moving large bodies of men over particular parts of the country. That depends now, as in ancient times, almost entirely on the water-supply, and the knowledge which has been gained by archæologists, such as Dr. Leaf and Sir William Ramsay, of the hydrography of the interior of Asia Minor, ought to be extremely useful in view of any operations that may take place at the present time. There is a route from Konia to Esk-i-Shehr which has never been crossed by an army. It is the shortest and easiest route, over practically flat country, and there is no apparent reason why an army could not cross it. It has never been done, and a fact which came out a few years ago gives us the reason. A drover was met taking some sheep across that route from Nighde to Eski-Shehr. He gave an account of the way he went. He went zigzagging across the plain in stages of about six hours each, and after each six hours he found a patch of grass, which indicated the presence of water. It is obvious sheep could travel in that way, but a great army could not.

As one who has sat at the feet of Dr. Leaf for many years, both as a student and as a teacher of Greek, I am very glad indeed to have come for the first time into contact with him in this way. I have known him as a geographer and as one of the brightest stars in the firmament of Greek scholarship in this country. It is pleasant to know that also in the outer world of finance he plays a part.

Dr. H. R. MILL: Asia Minor is one of those parts of the world where there have apparently been changes of climate of considerable magnitude since the early period of which we have been hearing to-night. What evidence recent historical researches have discovered as to date and duration of such changes I cannot tell; but it is undoubtedly true that in the centre of Asia Minor, as in the centre of Asia itself, there is an area where there is now considerably less rainfall than in the earlier days, though I have not any data sufficiently accurate to be worth offering as a contribution to this evening's most interesting discussion.

The PRESIDENT: It is impossible to discuss the military geography of any part of the shores of the Dardanelles without having the tragedy of the past twelve months present in our minds. We cannot readily put aside the story of an adventure, hasty in its conception, dilatory in its execution, and disastrous in its results. The bravery of our sailors and soldiers has indeed added a fresh record to the national roll of heroic deeds; but it was unavailing bravery, and it cannot console us for a loss of life scarcely paralleled in our military annals. It is not for us, it must be left to history, to apportion the terrible responsibility for these disasters.

Our business here to-night is not with the past except in so far as it may have lessons for the future. We must confine ourselves to giving an intelligent and critical attention to the main physical features of the Dardanelles and the adjacent shores, and to considering their bearing on military operations. There are, it seems to me, one or two obvious elementary facts in the problem of the Straits. The first of these is that under modern conditions it is a problem incapable of a naval solution. Warships, however formidable in the open seas, cannot hope to force the passage of Straits, over 30 miles long and in parts barely three-quarters of a mile broad, swept by a current down which mines float readily, and commanded on both sides by hills, the hollows of which afford ample concealment for innumerable guns. The defenders are supported by three physical obstacles: a narrow, tortuous channel, a strong current, and a complicated system of abrupt, intricate and impending heights.

The next fact—no novelty, but one imperfectly realized in this country a

year ago—is the nature of the ground composing the Peninsula of Gallipoli. To quote Mr. Buchan, a careful historian of the war, we "chose to attack the Turks in one of the strongest natural fortresses in the world." It is a fortress which, if not absolutely impregnable, is so formidable that a defender, especially a defender forewarned and allowed weeks for preparation, has a hundred chances to one of holding it successfully against any direct attack even from an assailant who has the complete command of the Ægean.

If the foregoing statements are accepted—and we have surely had sufficient practical proof of their accuracy—it remains to be considered whether this great natural bulwark of Constantinople is not capable of being successfully dealt with by more indirect methods, of being turned by the Asian or European flank. To-night we have been dealing only with the Asian shore. Dr. Leaf has given us the benefit of his intimate knowledge of that district. I gather that he thinks a landing in the Straits feasible—the French in fact effected one, but only as a diversion to our attack on Gallipoli—but that he rates highly the difficulties of the passage through the hills to the shores of the Sea of Marmara. I confess that I have been wondering how far his observations support this conclusion. We have seen photographs representing a country offering obstacles, it is true, but which compared to those of many regions now comprised in the seats of war are obviously insignificant. The banks of the Granicus, we were told, are 10 feet high, and the stream is fordable by carts. But I must not pursue this argument further to-night. I could wish Mr. Hogarth were here to take it up with local experience.

I shall conclude by citing from an authority I have already quoted, Mr. Buchan, some sentences which bear on the matter in hand. He writes: "To land in Gallipoli seemed the shortest way of accomplishing our desires. But it could only seem the shortest way to those who were ignorant of the nature of the ground and the quality of the Turkish defence. . . . There was no lack of people to give us accurate information; . . . there were scores of our countrymen who could have explained the precise difficulties of Gallipoli. . . . Gallipoli was not the only access to Constantinople. Troops might have been landed at the head of the Gulf of Saros to move through Thrace, or on the coast of the Trojan plain to advance along the southern shores of the Marmara. There were difficulties in both cases, but not comparable to those encountered at Gallipoli. In those areas the allied forces would have been able to move on a broad front and to fight a campaign of manœuvre battles."

Whatever the conclusion as to particular strategical plans, one broad moral seems obvious. It is one of supreme national importance, and one on which this Society has a peculiar right to insist. May we hope that in future in all military enterprises due account will be taken of local topography, of natural features and conditions. To fail in doing this is to run unjustifiable hazards and to invite lamentable disaster.

I am sure that we have all listened with the greatest interest to Dr. Leaf's lecture and appreciated the very clear way in which he has put before us the features of the Troad and the details of Alexander's march through it. Before calling on Dr. Leaf for any further remarks I should like to express, on your behalf, hearty thanks to him for giving us an excellent discourse.

Dr. LEAF: Lord Bryce, in the very kind remarks he made, put one or two questions which I think I might very briefly reply to. One suggestion he made was that it might be possible to land at the head of the Gulf of Adramyttium and march right round the eastern and northern side of the Troad as far as Lampsakos. I confess I should have thought that was quite out of the question.

I see my friend, Mr. Thacher Clarke, thinks the same. From the head of the Gulf of Adramyttium to the mouth of the Aisepos is about 70 statute miles. It is exposed to flank attack the whole way from the east. When you get to the mouth of the Aisepos, I think you would have about another 45 miles to Lampsakos—altogether about 120 miles. The last 45 would be exposed on its flank to the Sea of Marmara. I confess I cannot imagine any general would undertake such a march as that on a single line, without holding the whole of the interior of the country. The danger of it seems to me to be simply enormous. Lord Bryce asked a question with regard to the scrub on the plain of Granikos. I am afraid my photograph must have been misleading. On the plain of Granikos itself there is no scrub; it is all either grass or cultivated. The banks of the river are covered with bushes; the plain itself is almost bare and exactly suited to the phalanx. The passage of the river itself was, of course, not very well suited to the phalanx. The first attack appears to have been made by the light troops, and the phalanx must have been rather at a disadvantage. However, it did get across. The limestone and the granite near the Scamander Gorge do not belong to the Tertiary strata. The limestone there is part of the metamorphic skeleton of the Troad. I do not know exactly the age of that limestone; it is possibly Palæozoic; certainly not later than Mesozoic. The southern end of the gorge is igneous serpentine, with some granite in the neighbourhood. But that is part of the Secondary and, I think, later than the limestone.

I must not venture to follow Dr. Mill into the great desiccation question—I do not think there is any evidence on the problem in the Troad itself. The Southern Troad was famous for its fertility in antiquity, and there is no reason why it should not be equally fertile to-day, except that the Turk is no agriculturist, and very much prefers to make money, in the north by the valonea oak, which requires only the collection of the acorns once a year, and in the south by the olive, which requires little attention so long as the irrigation, which in this district is very easy, is kept up.

It was interesting to find that the olive forest is to a considerable extent in the hands of small owners, whose property is reckoned by trees, not by area; some owned as little as one tree. A large area, however, has passed into the hands of one firm. There should be material here for a curious study of small ownership in competition with the large estate.

GEOGRAPHICAL PROBLEMS IN BOUNDARY MAKING.

Colonel Sir Thomas H. Holdich, K.C.M.G., K.C.I.E.

Read at the Meeting of the Society, 3 April 1916.

THE political atmosphere will soon be charged with discussions relating to the revision of frontier and of international boundaries. What the physical nature of such boundaries should be—whether they should be designed so as to give special opportunity for the interchange of social courtesies and the promotion of brotherly good fellowship between contiguous peoples, as some writers and theorists who have a hopeful view of the regeneration of humanity advocate; or whether they should conform as far as possible to the nature of physical barriers opposing unauthorized

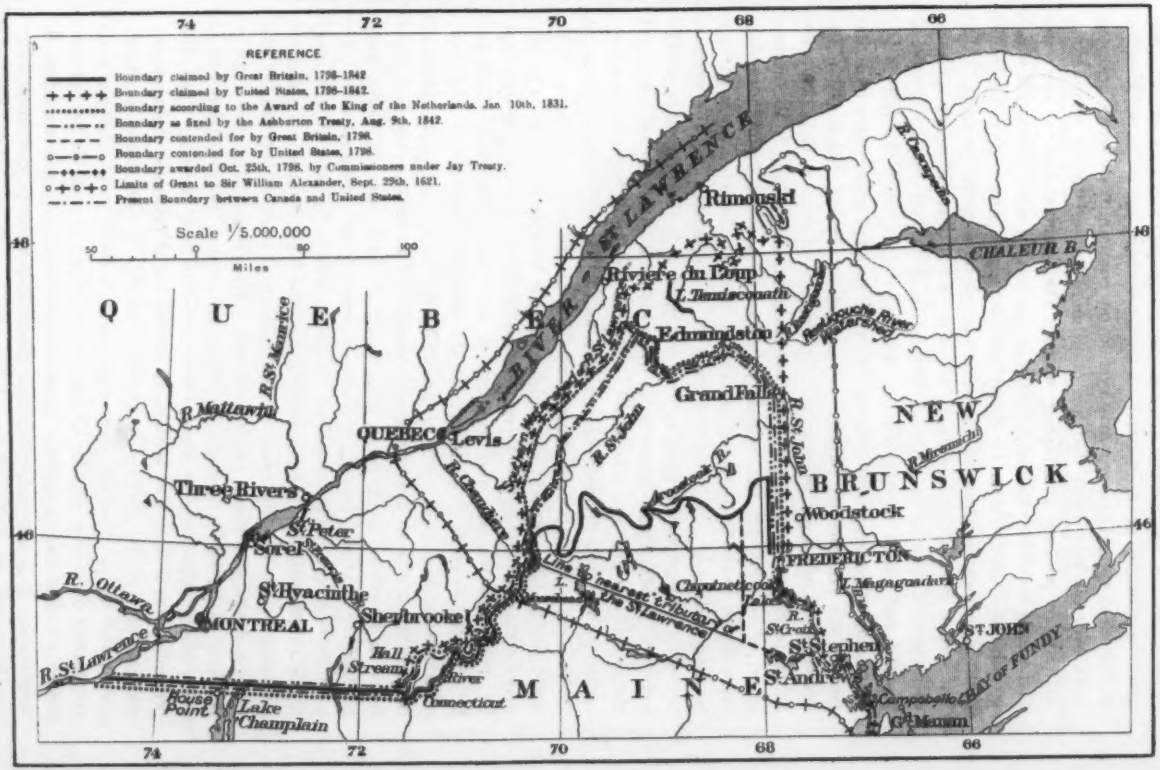
expansion and trespass into the neighbour's territory and thus destroy the germs of frontier dispute—such boundaries indeed as have been found practically necessary, is rather too large a question to tackle in one evening's paper. I shall confine myself to-night to a reference to some of the geographical problems which beset the business of boundary making, and endeavour to show you how the advance of elementary geographical knowledge within the last fifty years has minimized the difficulties and the dangers of international dispute arising from geographical ignorance.

The delimitation of an international frontier is the business of treaty makers who decide on trustworthy evidence the line of frontier limitation which will be acceptable to both the nations concerned, with all due regard to local conditions of topography and the will of the peoples who are thus to have a barrier placed between them. These are the two first and greatest considerations, and they involve a knowledge of local geography and of ethnographical distributions. Dependent thereon are other important matters which may largely influence a final decision—matters which may include military, political, or commercial interests, but all of which are subject to geographical and ethnographical conditions. It is only quite recently—within the last half century or so—that geographical knowledge has been considered an important factor (or considered a factor at all) in the education of the political administrator.

Fifty years ago the whole wide area of scientific knowledge embraced in the field of geography was narrowed to a ridiculous little educational streamlet which babbled of place names and country products. Scanty as was the educational value of geographical teaching fifty years ago, it was almost equalled in its feebleness by the practical knowledge of the subject which included the all important matter of map-making. True we had our geodetic scientists, and much profound thought and practical energy had already been devoted to solving the riddle of the Earth's form and dimensions, such as laid the foundation for an after extension of valuable bases for surface measurement which would sustain the building up of maps. But it was not the development of map-making alone which led to the better appreciation of the absolute necessity for scientific geographical education in the widest sense of the term. It was the discovery that we were being left very far behind in the field, not so much of pioneer research (there we have always held our own), as of that practical knowledge which profoundly affected our position as a commercial nation, our prospects in the military field, or our political dealings with other countries when the question arose of partition or spheres of interest, that forced the conservative hand of our educational administration and led to the formation of geographical schools throughout the country. In short, it began to be quite clear that geography was a science that had to be reckoned with, and which it paid pre-eminently to study.

We have found now by the experience of the last twenty to thirty years that certain provisional methods, methods which involve the use of a

EASTERN CANADA—UNITED STATES BOUNDARY.



smaller class of instruments and wireless telegraphy and lead to rapid progress in advance of strict geodetic measurements, are quite sufficient to enable us to spread out our map system on comparatively small scales of work over the vast areas that are of primary interest to the commercial, military, or political geographer, without the accumulation of any error that would invalidate the map. This is the sort of work nowadays which is voluntarily undertaken by many travellers, and which gives us results that are far beyond those of earlier geographical pioneers in value. It is this sort of work which is wanting whenever a political discussion arises as to respective spheres of national interest in wide and only half explored regions, and which usually remains wanting. It is often the fact of the possession of geographical data of the most absurdly elementary type that enables the commercial pioneer to succeed in striking effectively in the development of a fresh trade area. The details of such work concern the actual processes by which frontiers are secured, and belong to the demarcator, who completes the boundary demarcation when delimitation has taken shape in the form of an agreement or treaty between the high contracting parties. It is with the form of delimitation, and the primary necessity for trustworthy geographical information in the first place, and of sufficient geographical knowledge to prevent the misuse of technical terms that we are now concerned. This is an age of boundary making, of partitioning and dividing up territory, and it has by no means come to an end yet. It may well continue as long as the world endures. The territories to be partitioned, to which political boundaries have to be set, may be those of highly developed and well-mapped countries, or they may be dark and remote, and guiltless of any map-illustration which can be accepted as good enough to guide the work of demarcation. All sorts of countries, under all sorts of governments, from the black barbarism of Central Africa to the hot-house civilization of South America, have been subjected to the process, and of all of them may the same thing be said, *i.e.* that the process of frontier defining has resolved itself into a strictly geographical problem. It must always be so. A boundary is but an artificial impress on the surface of the land, as much as a road or a railway; and, like the road or the railway, it must adapt itself to the topographical conditions of the country it traverses. If it does not, it is likely to be no barrier at all. Boundaries have been twisted out of every conceivable natural feature with more or less success. The first preliminary to a boundary settlement should be, if possible, a reasonably accurate map of the country concerned; but this is not always available, and it may happen that the mere agreement between two countries upon an abstract definition may be all that is necessary or possible for the time being. In that case, a store of future trouble is laid up if, in the terms of delimitation, it is not made clear that this arrangement is provisional only.

Here, then, we find the first rock upon which delimitation treaties split. It is the want of geographical knowledge. If, indeed, it is compulsory

ignorance, if there is no possibility of waiting till maps can be made, the arbitrators are forced into the position of adopting the worst of all possible

SAN JUAN WATER BOUNDARY.

——— Boundary contended for by Great Britain.
..... Boundary contended for by United States.
+++++ Boundary awarded by Arbitrator, Oct. 21st, 1872.
------ Compromise offered by British Commissioner.

expedients—the straight line—then a provisional or inelastic agreement must take the place of a more elastic boundary.

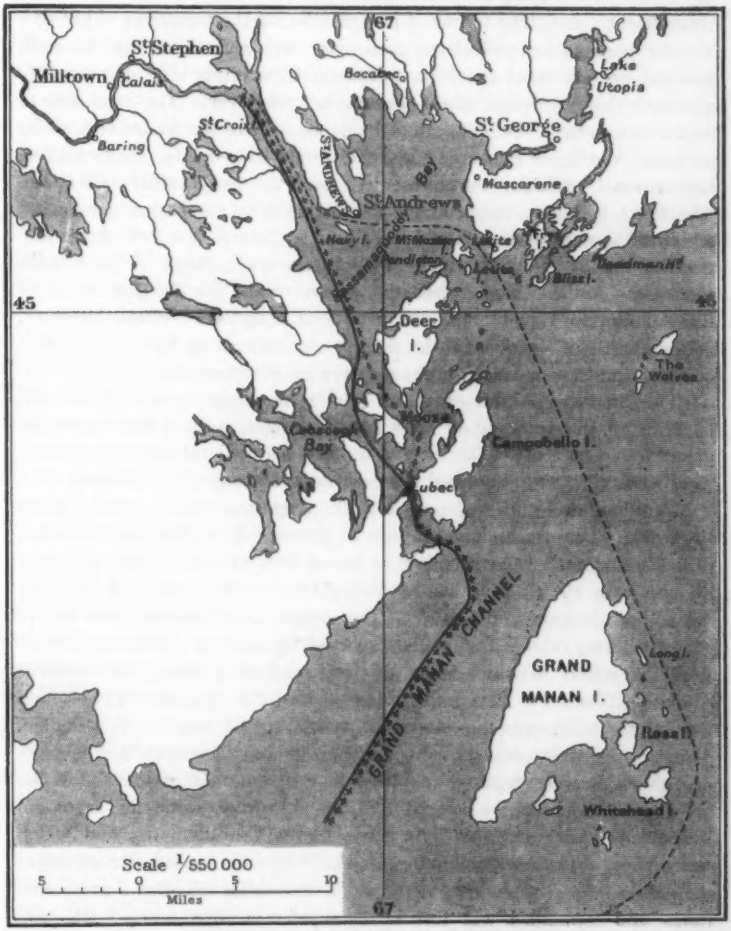
Some very notable instances have occurred lately in connection with boundary settlements in Central and Southern Africa which illustrate the

disadvantages of the straight line. In one case a meridian line was selected before even such preliminary investigations were concluded as might have determined a fairly accurate longitude and fixed a point on that meridian. The result was an awkward international complication as soon as it was discovered that a wide tract of valuable land had been erroneously assigned to England which subsequently had to be transferred to Belgium. In that case I think I am right in stating that quite enough of the geographical features of the country were known to decide whereabouts the dividing line ought to run, only unfortunately the meridian fixed upon did not happen to represent that line. There was little excuse for the mistake. In another instance a definite meridian was adopted which traversed a desert—the Kalahari desert—of South Africa. This is the eastern limit of what was German South-West Africa as it stood before the war. Now a desert may form an excellent frontier in itself, just as may the highest altitudes of a great range of mountains where the eternal snowfields and the remoteness of an uplifted wilderness are never trodden by the foot of man. It is true that even in deserts, African or Asiatic, wild nomadic tribes may exist who can band themselves together for mischief and who can raid across the frontier into each other's territory; and to them it may be desirable to point a landmark, either natural or artificial, and to say "You may not pass that mark." Outward and visible evidence of a barrier is the only thing they can understand. But how does a meridian help the matter? It is not only neither outward nor visible without demarcation, but it may be very difficult and very expensive to determine. In this case a lengthy series of geodetic triangulation had to be carried from Cape Colony to the south of the boundary till it entered German territory, entailing years of scientific labour in a most unwholesome climate, and costing a sum equivalent to the value of many thousands of square miles of useful geographical mapping, in order to determine with some approximation to scientific exactitude where that meridian really lay. This was before the days of wireless receivers and the interchange of time signals.

Next to absolute blank ignorance of the geographical conditions which prevail in the theatre of boundary operations perhaps the sharpest and most dangerous rock in the delimitator's course is an inaccurate or assumed geography on which to base his treaty. Perhaps the most remarkable instance in recent history of this form of delimitation error is afforded by the dangerous antagonism which arose between the two great South American Republics of the Argentine and Chile with reference to the partitioning of Patagonia. Patagonia had only recently emerged from primæval conditions of barbarism under Indian occupation. Opportunity for exploration had been small, and the usual result of geographical enterprise along the Pampas bounded by the Andine foothills had been disastrous to the geographer. Such knowledge as was at the disposal of the high contracting authorities who met in July 1881, to frame a treaty which should dispose of Patagonia between the two claimants, had been furnished

chiefly by old-world records of missionary enterprise which were seldom illuminating as map illustrations of the Andine territory. Later and

ISLANDS IN THE BAY OF FUNDY.



——— Boundary claimed by Great Britain.
- - - - - Boundary claimed by United States.
+ + + + + Boundary as fixed by Commissioners appointed under Article IV. of the Treaty of Ghent.

more scientific inquiries carried out by competent explorers revealed the fact that the text of the treaty was based on inexact geographical knowledge. Throughout the northern territories of these two republics

the international boundary for thousands of miles had been determined by a line which was eminently satisfactory to both parties. It was the great divide of the Andes which parted the waters of the Pacific from those of the Atlantic. Nothing could have been better. As a natural barrier it is magnificent; as a definite line of partition facing the trespasser either way it may perhaps be difficult to recognize here and there, but as such intervals are just those which no trespasser from either side can possibly approach this is a matter of no consequence whatever. The extension of such a line to the extreme South of Patagonia, where the Andes end, so far as South America is concerned, was the simple and effective solution of an international difficulty that presented itself to the political arbitrators. The treaty laid down the principle that Nature's excellent management for a central water-parting should continue to furnish the boundary, and decreed that it should be maintained by the main range of the Cordillera of the Andes which parted the waters of the Pacific from those of the Atlantic to a point near the Straits of Magellan. When, however, geographical explorers took the field it was not long before they discovered that the conditions of the treaty were irreconcilable.

The Southern Andes break up into a mountain system which still contains all the grandeur of snow-capped ranges, seamed by magnificent glaciers, and presents to the Pacific a snow-crowned rampart of majestic forest-clad hills, with, here and there at intervals, the white pinnacle of a volcano dominating its walls. But on the Argentine side it softens down towards the pampas and plains into a comparatively irregular formation of lower ridge and valley, flanked by broad terraces, scarlet and purple in autumn with all the glory of the Patagonian beech scrub, and infinitely varied both in form and feature. This lesser Cordillera encloses valleys of great beauty, and is frequently traversed by lakes of surpassing loveliness, the waters of which draw this way and that, taking their sources sometimes from the flats and "Masetas" of the Argentine plains, and passing right through the mountain system to an exit in the Pacific. This, to the treaty-makers, was unexpected and vexatious, and experts on either side were deputed to prove that the boundary could follow but one course, which course (according to the side from which the argument proceeded) was either the main range of the Cordillera (*i.e.* that which was highest and most dominating) or else it was the main water-parting—the great divide—of the continent, which sometimes followed a prominent range and sometimes was lost in marshy flats. War seemed the only possible termination of the dispute. Millions, many millions, were spent in ships and armaments, and the foundation was laid for an effective army trained on the latest military principles (German chiefly) on either side of the Andes. It really appeared as if a most natural assumption of geographical conformations which did not exist were destined to set back the tide of splendid progress of which both Republics could boast, and to wreck them on the shores of a long, bloody, and probably indecisive war.

Fortunately stern good sense prevailed in the end, and British arbitration, crowned with the King's award, was accepted with deep gratitude by some and, I am inclined to think, relief by all.

Another instance of assumed geographical data for the basis of treaty making that led to results which were certainly awkward and expensive and which might have been dangerous, occurred in connection with the Russo-Afghan frontier. There was once, not so very long ago, a Liberal Government led by Mr. Gladstone, which was anxious to bring the tension of doubt and suspicion which surrounded Russia's proceedings in Asia to an end, and at the same time to deal very gently with Russia's political sensitiveness. This was to be achieved by setting a boundary between Russia and Afghanistan, and thus to draw across Central Asia a hedge beyond which Russia's progression southwards should not extend. There followed a meeting between high diplomatic dignitaries on either side (in which British interests were represented by that worst of all possible treaty makers, Lord Granville) and the delimitation of the boundary was duly effected. There may have been worse delimitations perpetuated since that day—I am inclined to think that there have been—but there has never been one in which less precautions have been taken to ensure that the map geography of the regions in question was accurate. There is this much excuse for the light-hearted acceptance of the ancient maps then in existence, that for the greater part of the delimitation, the Oxus River was itself to represent the dividing line; and the Oxus River, no matter how much displaced on the map, was a great natural feature which could not be missed. The trouble came with the definition of a particular point—the post of Khwaja Salar—as a boundary objective on the banks of that river. Great rivers which wander untrammelled and free through wide alluvial plains of their own making are not to be trusted as permanently bound by any banks which possess no artificial means of defence against corrosive action, and the Oxus (a splendid boundary in its higher reaches) is no exception to the rule in the plains of Afghan Turkestan. Two commissions, the unwieldy British and the compact Russian, spent weeks of diligent searching, with the interchange of much political controversy, over that wretched post, which was not of the least importance, and which had been washed in by the river and swallowed whole many years before the commissions met. The worst result, however, was delay in the field of Afghanistan whilst an uncertain-tempered and gout-ridden Amir (who was exceedingly anxious to be rid of the commission) dominated the political situation. It was, indeed, exceedingly dangerous, and we were well out of it.

Assumed geography hardly works more havoc with frontier treaties than does the misapplication of geographical terms. The main points of the land configuration may be sufficiently well known; maps may be fairly up to date, and the setting out of an agreement may be based on points and features that are fixed and unalterable. And yet the terms

of an agreement may lead to most unpleasant discussion as to their meaning between rival commissions in the field, and may even be the means of breaking up proceedings altogether until the high contracting parties have explained themselves. Several such instances have occurred within my experience. One of the simplest occurred during the demarcation of the boundary between Afghanistan and those tribal territories which were to be reckoned independent and beyond interference by the Kabul Government. The boundary concerned passed through an open country—a country of hill and plain where the hills were sharply defined in long and generally continuous lines, sometimes knife-edged as to their summits, with steep rocky spurs deeply rifted by water channels. From the foot of the spurs there sloped away in smooth but often steep gradients the fans formed by detritus washed down from the mountain sides forming what is locally known in Baluchistan as "dasht." The "dasht" sometimes shaped itself into a broad and apparently smooth ramp seven or eight miles in width, a prairie land of low scrub and flowers in spring, a wide expanse of stone dusted slope in winter, which stretched between the foot of the mountain spurs and the meandering course of the nullah bed which formed the main drainage line of the valley. A very considerable length of the boundary which was to be based on the mountain range or ridge was defined as following "the foot of the hills." Here at once was the opening for serious disagreement—and the disagreement promptly arose. What was the "foot of the hills"? Was it where the steep rocky spurs ended and the sloping grades of the dasht began? Or was it where the nullah ran in the midst of the plain and the slope from the hills could descend no farther? In the latter case one would have expected the boundary to have been defined in the treaty as being the actual nullah bed rather than "the foot of the hills." That, at any rate, was the interpretation maintained, and the interpretation nearly led to a frontier war.

Another instance of similar slipshod definition occurred in the Asiatic highlands where the Pamirs spread out their gently sloping flats and valleys under the shadow of well defined mountain ranges. So vast and so rugged are these ranges that it is only by grace of a glacial ramp that they can be ascended, as a rule. The connection between the triangulation which should determine the points on which to base the boundary between Afghanistan and Russia in these uplifted regions and that which supplied us with a series of fixed peaks in the Himalayas to the south was exceedingly difficult. However, it was accomplished, more or less successfully, and Indian triangulation was carried into the Pamirs and connected with the Russian surveys. This was important scientifically for reasons which concerned the demarcation of a boundary based by Russia on astronomical determinations of latitude. All went well enough after the junction was completed and accepted for the purpose of supplying initial data. The trouble arose when approaching the end of the demarcation; the boundary

was defined in the treaty as running to the Chinese frontier. The definition was as follows: "From this point the boundary shall run in an easterly direction to a junction with the Chinese frontier." What is an easterly direction? A little north of east? A little south of east? Due east? The expression was indefinite, and the interpretation involved the question of certain passes (whether they were of value or not we need not stay to inquire) which were considered as important at the time. The short summer and autumn were drawing rapidly to a close. Snow was settling deep in the passes Indiawards, and it seemed possible that ere an answer could be received to the simple question, "What is an easterly direction?" the camp of the commission would be snow-bound in those vast altitudes and condemned to an Arctic existence for the next six months. Naturally there was no agreement between English and Russian camps; and they arranged to separate for the winter. Much expense was incurred in collecting fuel and selecting the best shelter available for the next six months. It fortunately happened, however, that the weakness in geographical expression had been recognized in time. It appeared to be so certain to lead to complications as to justify an early reference to the chief contracting authorities in anticipation of such complications; and the reply, which determined the conclusion of the line on the basis of ascertained topography, was received just in time (and only just in time) to enable us to escape over the passes, already deep in snow and thickly shrouded with menacing snow mists, back to sunny India.

It is true that geographical nomenclature is by no means fixed. The question has been discussed with great diligence and careful research both by the Royal Geographical Society and the Geographical Society of America, but it is not with reference to the actual facts of land conformation in nature that trouble usually arises. It matters not much whether the technical classification of land-forms is geodetic, based on the geological history of the formation, or whether it is simply physiological description expressing the character of the form in terms of its relation to other geographical features; whether the names of such features have a foreign derivation, or whether they are pure Anglo-Saxon, so long as the geographical definitions contained in a boundary treaty are technically accurate and precise in their meaning. Probably the actual loss to England due to the promulgation of boundary treaties drawn up with little or no regard to simple precision in statement could be reckoned in millions of pounds sterling. If a man were making a will full of complicated provisions, he would employ a lawyer armed with the full technical vocabulary of that rhetorical profession to make it for him. If he wishes to put a hedge between his own and his neighbour's estate he would take care that the agreement was correctly worded. But in defining a boundary between one nation and another not even the most elementary knowledge of geographical nomenclature has seemed to be considered necessary. To take the case already quoted of the boundary disagreement between the

Republics of Argentine and Chile: nearly all the trouble arose from the interpretation of the words "main range." What is a main range? I could give you many other examples of equally indefinite description, but there is not space.

There is yet another shoal in the intricate sea of delimitation (even when the delimitation is based on sound topography) and that is the selection of some impossible geographical feature to carry the boundary. This is indeed not very usual, but it is very fatal to rapid and satisfactory progress in demarcation. An instance of this occurred in demarcating that part of the Indian boundary which separates Chitral (and Kashmir interests) from Afghanistan. Here the agreement defined the boundary as running parallel to the Chitral River at an even distance of four miles from the river bank. Thus it fell on the spurs of a flanking range, about half way between the summit and the foot, festooning itself from spur to spur, cutting across mountain torrents and dividing water rights in accessible valleys, a continuous line of ascent and descent over some of the wildest, ruggedest and most inaccessible mountainside country that the Indian frontier presents, albeit it overlooks one of the loveliest of frontier valleys. Demarcation was an utter impossibility nor could, or would, any tribesman of that wild Pathan frontier pretend to recognize such a line without an infinity of artificial boundary marks. Fortunately, it was possible to suggest an alternative without any great loss of time, and as that alternative was the well-marked crest, or divide of the range, instead of being halfway down its rugged side; and as the alternative would include a certain concession of (utterly unimportant) territory to the Afghans, there was no great difficulty in effecting an alteration in the text of the agreement. Here again the hazard of the business was delay.

References to a few of the difficulties which have occurred in the interpretation of comparatively recent boundary treaties owing to lapses in scientific geographical description only prove that until lately the great principle of recognizing the geographical function of boundary demarcation, before proceeding to political definition in detail, was misunderstood. Quite recently, however, many boundaries have been settled in many quarters of the globe (especially in Africa and in South America) which have led to no disastrous disputes whatever, and have called for no arbitration. This is a satisfactory proof of the gradual development of geographical teaching for which the Royal Geographical Society may fairly claim a share of credit. To illustrate the advance made in geographical definitions we may refer to the position of geographical knowledge in the eighteenth century. Geographical terms in treaty definitions in those days were so vague as to be almost grotesque. There is one treaty with its attendant interpretations and the disputes arising therefrom which makes a good story, and is worth a reference, if only to set a point to our satisfaction at the gradual development of this branch of practical knowledge. The negotiations for the Canadian

boundary from the Bay of Fundy to Juan de Fuca have really lasted into this century—but they commenced late in the eighteenth century. In November 1782, representatives of Great Britain and the United States signed at Paris a provisional treaty of peace. It acknowledged the Independence of the United States. Article II. provided that between the United States and Canada "it is hereby agreed and declared that the following are and shall be their boundaries, viz., from the north-west angle of Nova Scotia, viz. that angle which is formed by a line drawn due North from the source of the St. Croix River, to the Highlands; along the said Highlands which divide those rivers which fall into the St. Lawrence from those which fall into the Atlantic Ocean, to the north westernmost head of the Connecticut River; thence down along the middle of that river to the 45th degree of north latitude; from thence by a line due west on said latitude until it strikes the River Iroquois or Cataraquy; thence along the middle of the said river into Lake Ontario," etc. The definition then deals with the series of great lakes and their connecting streams till the boundary reached the lake of the Woods. "Thence through the said river" (lake of the Woods) "to the north-western point thereof and from thence on a due west course to the river Mississippi" . . . "East by a line to be drawn along the middle of the River St. Croix from its mouth in the Bay of Fundy to its source, and from its source directly north to the aforesaid Highlands which divide the rivers which fall into the Atlantic Ocean from those which fall into the River St. Lawrence; comprehending all islands within 20 leagues of any part of the shores of the United States and lying between lines to be drawn due *east* from the points where the aforesaid boundaries between Nova Scotia on one part and East Florida on the other shall respectively touch the Bay of Fundy and the Atlantic Ocean; excepting such islands as now are, or heretofore have been, within the limits of the said province of Nova Scotia."

On 3 September 1873 a definitive Treaty of Peace was signed at Paris in which Article II. was repeated as above.

For geographical information the negotiators were dependent on a map issued in 1755 called Mitchell's map. It appears to have been a better map of North America than any previously published, but it was a fact which must have been well known to the negotiators that much of the country was absolutely unexplored. The childlike faith with which that map was registered as the basis of an important treaty sufficiently indicates the value set on scientific geography in England in those days. The following difficulties immediately presented themselves to the demarcators.

1. Where was the river St. Croix? There were two rivers 50 miles apart, either of which might be the St. Croix of the map. The name was unknown locally.

2. What was the source of the river which was finally decided to be the St. Croix (in reality the Schoodic) supposing it had two branches (which it had)?

3. What was meant by the *north-west angle* of Nova Scotia? Where was it?

4. What were the Highlands? Did they merely represent a divide, or were they actually hills?

The discussion of these questions lasted for many years. There was a long period of acrimonious dispute lasting about fifty years over the question of the Highlands alone, during which we were more than once on the edge of a war with the United States, and geographical theories were put forward which would lead to the conviction that a sense of humour has only recently been acquired by Americans. An ancient grant of all Nova Scotia made in 1621 to Sir William Alexander and defining the borders of that province was produced in evidence of former boundaries, from which it was clear that the expression "due north" from the source of the St. Croix had been substituted in the treaty for "northward"—and the western branch of the St. Croix (or Schoodic) had been adopted for the eastern. The first piece of pedantry cost England all the northern half of the state of Maine; the latter was not of great consequence. The "Highland" question was finally referred to the King of the Netherlands for arbitration, and that wise monarch, with the geographical acumen of a Dutchman, at once put his finger on the weak spot, and after pointing out that boundary disputes based on apocryphal geography must ultimately end in compromise, he decided that a divide was not necessarily hilly or mountainous, and awarded a line from the head of the St. Croix northwards as a "line of convenience" to the "north-west angle of Nova Scotia," and from thence by the St. Lawrence-Atlantic divide to the head of the Connecticut (which river also had two heads). The award did credit to his position as king of a nation of practical geographers; needless to say this did not satisfy the disputants, and the boundary finally accepted departs from the divide (to the advantage of Britain) for a space sufficient to destroy its value as a true geographical barrier. This arbitration treaty was signed in 1842. The area in dispute amounted to about 12,000 square miles, of which about 5000 fell to Britain, who made concessions about the head of the Connecticut, where the 45th parallel had been wrongly determined.

Long before this fierce antagonism had been roused by the question of the fishing rights, and the ownership of islands in the Bay of Parquamoddy into which the St. Croix debouches. The geographical definition of a bay was called in question as soon as it was admitted on both sides that the "due east" of the treaty meant "due south." Was the Parquamoddy Bay a part of Fundy Bay? Was Fundy Bay the Atlantic, etc.? Difficulties here were not finally disposed of till the year 1910. From the head of the Connecticut to Wood's Lake there was no fundamental ground of dispute. It was found that the great chain of lakes really did link up one with another, and the only question that arose was in connection with islands in those lakes. In Wood's Lake, however, it was speedily

discovered that no line running west from the north-west corner of the lake would ever reach the Mississippi; inasmuch as that river rose south of the lakes. Consequently the effort to reach the Mississippi was abandoned, and the 49th parallel of latitude was adopted as the international boundary under the mistaken impression that it was the northern boundary of Louisiana. The nature of this extraordinary boundary from the Lake of the Woods to the sea need not be referred to, but the final difficulty of San Juan's Island renders this story of an historical geographical muddle complete. The treaty maintained that the boundary was to follow the 49th parallel to the middle of the channel between Vancouver and the mainland, and thence pass southwards following the middle of the channel round the mainland. But between Vancouver and the mainland south of 49° north latitude there is an archipelago of islands, and at least three channels that might be called main channels leading through them southwards. Chief among these islands was San Juan. In 1859 a pig was shot by an American on San Juan and the American was haled before a British magistrate and threatened with imprisonment. This put a climax to the dispute, American honour was touched, and troops were landed from both sides. It looked as if the pig incident would lead to war; but the position was saved by arbitration, the Emperor of Germany being appointed arbitrator. The award gave away the whole archipelago to the United States.

It may be added that in 1870 the Canadian boundary at Pembina was found to be 4700 feet south of its true position in parallel 49°. This was rectified and the work completed in 1874. Demarcation was effected in 1908. It has only just been completed (if indeed it is complete), but the cost of maintaining it will last through all time.

Absurd as are many of the incidents connected with the Canadian boundary, it may be doubted whether the Alaskan muddle was not almost equally remarkable. It was primarily caused by the purchase of Russian territory in Alaska by the United States, which included a strip of coastland extending roughly from Mount St. Elias in South Alaska to Cape Muzon and the Portland Canal to the west of British Columbia and bordering the Pacific. After much negotiation a convention was concluded at Washington in January 1903, which was to decide the position of the boundary by reference to a tribunal. The difficulty of decision arose chiefly from the original terms of delimitation in the treaty of 1825. The boundary was to run northward from the 56th degree of north latitude (*i.e.* the head of the Portland Channel—or canal) "following the crest of the mountains situated parallel to the coast until its intersection with the 141st degree of west longitude, subject to the condition that if such line should anywhere exceed the distance of 10 marine leagues from the ocean then the boundary . . . should be formed by a line parallel to the sinuosities of the coast and distant therefrom not more than 10 leagues. If any continuous range such as the treaty demanded had existed with a crest

uniformly parallel to the coast it might have been an ideal boundary, but the geographical impossibility of such a disposition of nature seems hardly to have been recognized, and the question resolved itself into the determination of an irregular line in a mountain region which should never be more than 10 leagues from the ocean, and which should accord as far as possible with the condition of parallelism to the coast. This involved the secondary question of what is the coast line in such an archipelago of islands and islets as that with which the tribunal had to deal. The condition of strictly following its sinuosities was an impossible one. The tribunal finally decided on a line which was a mountain boundary practically in accordance with the contention of the United States. The line joined certain peaks marked on a map attached to the award forming a sinuous boundary about 30 miles from the general trend of the shore, and is, presumably, a line which it would be impossible to demarcate. The question of the course that the line should take from the point of commencement to the entrance to the Portland Channel formed an important branch of the award. This involved the right of occupation to certain islands. By the decision of the tribunal (with the strong dissent of two of the British members) the channel of the treaty was decided to be that which passes to the north of Pearce and Wales Islands, and which transfers two other important islands, Silklan and Kanna-ghunut, commanding the channel, to the United States, from Canada. The indignation which was aroused in Canada by this decision is a matter of comparatively recent history. It did, in fact, ignore one of the most important principles of boundary making when a compromise is in question. In the scheme for a fair and useful division between rival claims generally, it is most important to preserve the entity of any one concession in particular. For instance, to divide a valley so that water sources are on one side and the irrigable lands on the other, is merely to invite the trouble which it is the whole object of a boundary to prevent. In this case the right of navigation through the channel to Canada, and the command of the channel to America by the cession of these islands, certainly seems to be a mistake.

The PRESIDENT: Turning to our business for the evening, as you will have seen, Mr. Compton, who was to have read a paper on New Caledonia, has been prevented by illness from doing so. In these circumstances our old friend and Vice-President, Sir Thomas Holdich, has come forward at very short notice and proposes to read a paper, which I am sure will be interesting, on a subject on which he is better qualified to speak than anybody in this country, that is, on frontiers and how they have been, and ought to be, demarcated.

(*Sir Thomas Holdich then read the paper printed above and a discussion followed.*)

Sir FRANCIS YOUNGHUSBAND: Sir Thomas Holdich is, I suppose, the greatest authority in the world on the practical work of demarcation of frontiers. He has demarcated the frontiers of various countries from the Andes to the Himalayas. It is commonly assumed by the man in the street that Governments are extremely stupid and lacking in foresight; but Governments do have

lapses of intelligence and sometimes show a certain amount of foresight. It is quite twenty years ago that the Home Government telegraphed to the Viceroy of India asking him to advise them as to what should be the permanent frontier between the Russian and Indian Empires to the north of India, in order that the Government might know up to what point they should extend their influence if necessary, and beyond which line they should on no account involve themselves in liabilities. I happened to be at Simla at the time when this telegram arrived, and was asked by the Foreign Secretary to mark on the map what in my opinion should be that frontier between the Indian and the Russian Empires. I had in the years 1887, 1889, 1890 and 1891 been exploring on the northern frontiers of our Indian Empire, and the Government at any rate on that occasion not only showed foresight in asking for information as to a good line of frontier, but they did also as a matter of fact consult the man who had had some experience of it on the spot. It happens, however, that when foresight is shown the event foreseen does not always come to pass, and the advance of the Russians down towards our Indian Empire in the north which had been anticipated twenty years ago has not occurred from that time till now. Sir Thomas Holdich has referred to the unsuitability of the River Oxus as a line to mark the sphere of influence. That line was suggested by Lord Granville in the year 1873. Looking at a map the Oxus seems to furnish a very suitable line between ourselves and the Russians, and here in London it had been assumed that the River Oxus would be an adequate line between the Russian sphere of influence and the British up from India. But in the lower parts the river, as Sir Thomas Holdich has shown, wanders over a wide open plain and becomes an exceedingly unsatisfactory boundary. In the upper parts Sir Thomas thought it was a better one, but my impression in that region was that even there also the river is not a good boundary, because in certain states there are villages on both banks. The villages on one side we have given to the Russians, and the villages on the other side we have kept for Afghanistan. I remember years ago as a young officer out in India, like many other young officers, thinking the Government at home very simple-minded, that they should believe that by simply laying down boundary pillars in the wilds of Central Asia they would keep back the Russian advance towards India. We thought the Russians would not pay much attention to those lines of pillars in the middle of deserts and mountains. But the boundary was demarcated by Sir Thomas Holdich and other officers, and it is a fact that from that time to this it has been strictly respected by the Russian Government. Since 1891 when I was myself arrested on the banks of the Oxus there has been no frontier "incident" between us, and I think that is an exceedingly satisfactory thing to be able to say.

Colonel C. E. YATE: I think after what Sir Thomas Holdich has told us there is little I can say. I think he has explained most thoroughly to us the extraordinary difficulties that have to be met by the laying down of boundaries by our Government in advance over lines of which they had no knowledge. He has given us instances of all sorts of different definitions of boundaries—mountains and rivers, and a boundary that was to run, as he told us, "about 4 miles from the river," and he has showed us in his photographs how utterly impossible it was to demarcate such a boundary. He has also recalled to us instances of boundaries defined as running "along the foothills," and pointed out how impossible it was to find out what the "foothills" were, and how hopeless it was to endeavour to come to any agreement on such definitions. Naturally where there are foothills the people in the plains work their way up into the little valleys between the various spurs to a considerable distance,

and I can remember a case in my own personal experience in which this had led to all sorts of troubles and fights and encounters between the two parties. It was a tremendous difficulty to settle a boundary along "foothills." Then again the lecturer illustrated to us the disadvantages of a "straight line." When you come to settle a boundary, the watershed of a mountain range or a big river with fixed banks is the only really permanent geographical feature you can fix a boundary on satisfactorily. If you can only get a divide between two countries you may then get a permanent boundary. All artificial boundaries lead to trouble. We can thoroughly realize the enormous expense incurred in maintaining that long straight line of the Canadian boundary which Sir Thomas Holdich has told us about. We can only hope that this laying down of boundaries in advance without any geographical knowledge of what the countries are like through which the boundary commissions have to work will cease in the future, and that the Government will come to this Society and to other sources where information is available as to what are the real natural features of the country through which the boundary has to be laid down before finally deciding upon it. Sir Thomas Holdich has told us how much good work the Society has done, and I think we can only trust that this will be recognized by the Governments concerned in the future, and we hope there will be more reference to the Geographical Society than there has been in the past before future boundaries are agreed to.

Prof. SPENSER WILKINSON: I do not think we have heard anything to-night that requires criticism in the sense of fault-finding or disagreement. I should like to say I have had this evening a very rare and great pleasure in hearing a most interesting subject expounded by probably the most competent man in the world to present it, and we have heard two other gentlemen following him who are, as near as can be, the men who, next to the lecturer, have the largest experience of this business. I discussed the matter a good many years ago with Sir John Ardagh, who had a good deal to do with the demarcation of the frontier between Greece and Turkey, and there is one remark I should like to be permitted to make. We have heard the difficulties of demarcating the frontier after it has been delimited by diplomatists, and it no doubt seemed as though diplomatists were very stupid people; but I should like to say a word, not in defence of anybody, but to explain how this may come about. As a rule these frontier disputes arise in conditions which, as you have heard, are very likely to lead to wars. Feeling is much strained on both sides, and we have two countries finding they may come to war on a point of honour when it is really a question of geographical definition. Consider what the unfortunate diplomatists have to do. They want to avoid a war, and at last they hit upon a form of words on which both sides can manage to agree, and this formula is given to geographers to interpret. I am rather inclined to think it is quite worth while to pay the expenses of the geographers and to give them all the difficulties of the demarcation, rather than to have a war over the question. I think you will find many of these questions, as soon as they touch national susceptibilities, always become increasingly difficult. There was the instance of the Newfoundland Fisheries which caused a great deal of trouble between France and this country. If you go back and look at the negotiations you will find that the unsatisfactory definition of the Treaty of Utrecht was repeated several generations later in the Treaty of Paris, and the fact was that the political relations between the Governments did not enable the British negotiators to press their point as far as they might have done You generally find that where there has been an unsatisfactory boundary it has been because

the Government which negotiated it did not feel inclined to press its view to the point of war, and was ready to compromise in order to get a treaty. That is very often the reason why you get these unsatisfactory definitions. These were the conditions when Gladstone's Government negotiated with the Russian Government about the border of Afghanistan. The real difficulty lay not primarily in geographical definition, but in the view which this country was taking of policy. It was a period when we had a Government very anxious to keep the peace rather than to be self-assertive. You see the results in the trouble afterwards caused to the geographers. I do not think these difficulties are primarily due to the carelessness of Governments in regard to geographers, but rather to the weakness of policy or to the beliefs prevailing as to what policy should be. I think you will agree with me that the progress of geography has made geographical definition very much easier than it was fifty years ago or a century ago, and where policy is satisfactory, I do not suppose there is likely in the future to be very much difficulty about a reasonable delimitation, which will probably leave comparatively—I won't say easy—but less ambiguous than it used to be, the subsequent work of demarcation. I should like to express the delight with which I have listened to the lecture and the instruction I have derived from it.

Mr. H. F. J. BURGESS expressed a desire to raise two points. He objected to the introduction of politics which had taken place since the war at the Society's meetings. He also disapproved of the employment of military men in the arrangement and demarcation of frontiers.

The PRESIDENT: I must first deal summarily with the last speaker's remarks. It is true that, in so far as they affect "party," Politics have as a rule been excluded from our discussions. But where national interests and geographical knowledge are bound up together this custom does not hold good; least of all can it do so at a time when "party" is practically in abeyance. As to the second point, a more unfortunate occasion than the present for raising it, for disparaging the work done by our engineer officers in delimiting frontiers, could hardly have been chosen. As all who have followed recent events in South America are aware, the delimitation between the Argentine Republic and Chili, carried out at the request of the Governments concerned by Sir Thomas Holdich and his colleagues, has been the means of preventing a war which threatened to be long and ruinous to two young and growing States. So highly was their work appreciated in South America that when a similar dispute arose between Peru and Bolivia the statesmen on both sides applied for the help of British officers, with this difference—that instead of appealing to His Majesty's Government they came to the Council of the Royal Geographical Society and begged us in the final resort to act as arbitrators.

I proceed to the general question. During this Session we have had several lectures on frontiers in civilized countries. I fear that in Europe the ideal frontier from the professorial point of view will never be attained. There are too many factors to be taken into consideration: there are the physical, racial, commercial and military factors, and it is very rare indeed that you get such a perfect frontier as the range of the Pyrenees—or, I may add, the British Channel. I am afraid we shall never see absolutely scientific frontiers (scientific from every point of view) between old countries. Nationalities show no proper respect for water-partings. In new countries, however, it is a different matter. There the difficulties are of quite another order. I confess I have been very much interested in hearing Prof. Spenser Wilkinson's apology for statesmen and diplomatists, for I felt during the lecture that they very much required

some apology. I cannot, however, entirely fall in with his line of argument. Their frequent vagueness may possibly on occasions have saved us from war, but it seems to me that it has far more often brought us to the very edge of war, if not actually into war.

We have had some curious instances given us to-night. It throws an odd light on the psychology of nations, or their rulers, when we are reminded that the United States were once not too proud to be ready to fight for a small Pacific island! When we hear of such incidents as the way in which the boundary of Uganda and the Congo State was drawn along an unascertained line of longitude we cannot but feel that the diplomatists had better have consulted geographers and travellers before they committed themselves on paper. Their traditions stood in the way: what these traditions were I may best illustrate by a personal anecdote. Some years ago, while I was one of the Honorary Secretaries of the Society, I received an official letter from the Foreign Office signed by the then Secretary of State and sent in reply to a protest made by the Council against the exclusion of Geography from the subjects for examination for Foreign Office clerks. The gist of the letter was, that all the geography needed by a Foreign Office clerk could be picked up in his first few months in the Department.

Again I call to mind how one of our most distinguished Proconsuls, the late Sir Lambert Playfair, told me that only once on his many returns from foreign posts had he been met on reporting himself at the Foreign Office by anyone who cared to ask questions and listen to his replies. The exception was our frequent guest, Lord Bryce. I remember too a chance meeting with Sir John Kirk, when he exclaimed, "My life's work in Africa has just been given away in London." To-day we can reflect with satisfaction that General Smuts is putting that right, and that Kilimanjaro, the top of Africa, is no longer a German mountain!

I would not deny that there is something to be said in excuse of the official attitude. It is hard on statesmen to be called on to give their attention to details in matters which are alien to their usual interests. But where the political or military business in hand is seriously affected by geographical facts and considerations these must be taken into account under pain of disastrous consequences. It is needless to give recent instances. This war will make many changes; may we hope that among them will be a change in our official attitude, and that we shall learn to think geographically as well as imperially.

I must add, in conclusion, one word of thanks to my old colleague Sir Thomas Holdich for having come at very short notice to our rescue and given us such a masterly discourse.

NIGHT MARCHING BY STARS.

E. A. Reeves.

Read at the Afternoon Meeting of the Society, 13 *April* 1916.

THE subject which I have been asked to bring before you this afternoon is doubtless one of the oldest with which we could possibly deal. The heavenly bodies have from the earliest days been the natural guides of the traveller. Long before the magnetic compass was known, at any rate in Europe, men found their way across unexplored oceans and

trackless deserts by the sun by day and the stars by night; and the same guides are used by nomad tribes at the present time. So long ago as the seventh century B.C. Thales, the Greek philosopher, had taught the Ionian sailors to use the stars and to steer by the Little Bear, like the Phœnicians.

As centuries passed and the magnetic compass began to be generally used, it appears that this time-honoured method of finding the way about gradually became superseded, and instead of the heavenly bodies serving as ready guides for rapid marching, their use has, in civilized countries, been confined almost entirely to instrumental observation for fixing positions of definite points.

It is, of course, impossible to overestimate the value of the magnetic compass, and I should like to state at once that in my opinion star marching should be considered more as a means supplementary to ordinary compass marching than as rivalling it. Still the compass is not always at hand, and often most unreliable when it is. In any case a man cannot go along with his eye fixed on the compass card the whole time, and must have distant points to march on. In the daytime mountain tops and other terrestrial points are chosen, the compass bearings of which have been previously found, but when it is dark these are of course invisible, and some luminous marks are necessary, the most serviceable of which are those provided by Nature, the infinitely distant stars.

If a man has a sufficient knowledge to use the heavens as a compass at night, he is not dependent on his magnetic compass; and if, as frequently is the case, specially during military operations, he finds himself without a compass, or that it is not to be relied upon, he never need go in an absolutely wrong direction, as I know has frequently happened. On several occasions during this present war I have been told by those who know that men have, with the stars shining around them, mistaken their direction and marched straight into the arms of the enemy, thinking they were going to their own people. Now there is no need for this sort of thing to happen, and very little practical instruction beforehand should have prevented such mistakes. I have during the last few months occasionally been asked to lecture to troops in training, and have found that they readily pick up sufficient knowledge to march by the stars.

What it really comes to is that a man who can properly use the stars for marching has, on any starlight night, instead of a little compass card measuring only an inch or two in diameter, the whole vault of heaven for his compass.

Still, after all, this only furnishes another means of determining direction just as the compass does, and it cannot, any more than that, guide a man unless he knows what direction he wants to march in. Not long ago a man wrote to me to ask how, if he got absolutely lost on a dark night and did not know which direction he ought to go in to reach his destination, he could find this out by the stars. I had to inform him that there was no such magical influence that I knew of in the stars, but if he

knew whether he ought to go north, south, east or west, the stars would point out that direction for him.

It is satisfactory to find that there is now an increasing interest in this subject, and several officers, realizing its great practical importance, have published tables and practical instructions that should be of considerable assistance.

Lieut.-Colonel W. A. Tilney (17th Lancers), who has devoted much time to the matter, was one of the first to direct my attention to the great value to troops of star marching, and the method which he worked out, after receiving instruction from me, was first used with excellent results a few years ago in India on long marches, and I understand has since been of considerable service at the front in France. It has been highly commended by military officers, and Sir Douglas Haig writes that the "method has been tested and found successful." Later on I shall refer to this and other methods of finding star bearings, but we will begin at the beginning and first of all see what is the nature of the problem that presents itself.

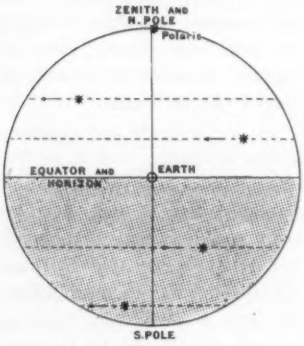


FIG. 1.

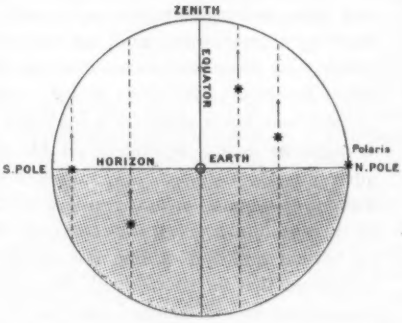


FIG. 2.

It is clear that if the stars were fixed points in the sky they would at once provide the necessary luminous marks for guidance at night, for having once learnt to identify them, or the brighter of them, we could use them just as we do landmarks in the daytime; but the trouble is that they are not fixed, and they appear in different lines of bearing at different hours of the night and seasons of the year for even the same place on the Earth's surface. This apparently complicated movement, combined with the supposed difficulty of identifying stars, has led many to suppose that the matter cannot be understood without a great deal of study, and they have therefore abandoned the idea of using stars for finding direction altogether. But this is entirely a mistake, as I feel sure that any who have given attention to the subject will admit.

In matters of this kind I always think it well to begin at the beginning, and I will therefore ask you to bear with me while I refer to a few

elementary diagrams, so that we may see what really takes place; and after that I will deal with the various devices and methods for rapidly finding the bearings of stars at any time, and then endeavour to show how these bearings can be made use of for the purpose of marching even by those who have no knowledge of astronomy, except just enough to identify a few of the brightest stars.

Owing to the rotation of the Earth on its axis, the stars appear to pass round the heavens from east to west in twenty-four sidereal hours. In Fig. 1, suppose a man situated on the North Pole of the Earth, then the pole star, which is within about $1\frac{1}{4}^{\circ}$ of the celestial pole (*i.e.* the continuation in the sky of the Earth's axis of rotation), will be stationary practically over his head, and all the other stars will pass round him in circles. The horizon line will coincide with the equator, and the N. pole with the zenith. Only those stars north of the equator will be visible, there will be no rising or setting, and the altitude of any particular star will always be the same. Whichever way the man turns he will face south. The same holds good at the South Pole, except that there only the stars south of the equator could ever be seen, and the face must be always towards the North.

Next, in Fig. 2, suppose a man to be standing on the equator, then the pole star will be on his northern horizon, the zenith will be on the celestial equator, and the stars will pass in circles at right angles to the horizon. In this position all the stars would be visible at some time or other, if they were not intercepted by some obstruction near the horizon line.

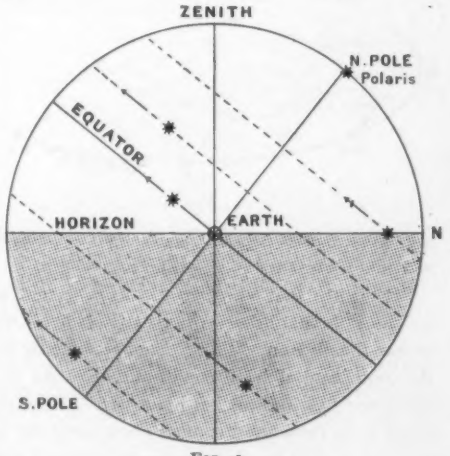


FIG. 3.

In any latitude between the equator and the poles the condition would be something like that shown on Fig. 3. The pole star would be practically stationary at the north pole in the heavens, at an angle above the horizon equal to the latitude of the place, and all other stars would describe circles in the sky as shown by the lines with arrows. Those near the North Pole would never go below the horizon, while those near the South Pole would never come above it. Any star exactly over the equator would rise due east and set due west, while all the others would rise at different bearings round the horizon-line as shown by the position where the star

lines, with arrows, cut the horizon, and would set at corresponding angles on the opposite or W. side of the horizon. It will also be seen that all stars must be on the N. and S. line when they have reached their highest or lowest altitudes, that is when they are on the meridian. Fig. 3 represents the case for about the latitude of London. The next, Fig. 4, shows the same thing perhaps more graphically as a sort of bird'seye view.

It is important to remember that all stars rise and set exactly at the same bearing for the same place on the Earth, at any season of the year, although the time of their rising and setting, as shown by an ordinary mean-time watch or clock is constantly changing, and is nearly four minutes earlier every night, or about half an hour earlier every week. This is due to the Earth's path round the sun making the sun appear to move in a circle amongst the stars in a year.

It is surprising how few people know anything of even these elementary movements, and an officer to whom I was trying to explain something of the subject the other day appeared to think that the stars moved about all over the sky much as they pleased, with little or no common connection with one another.

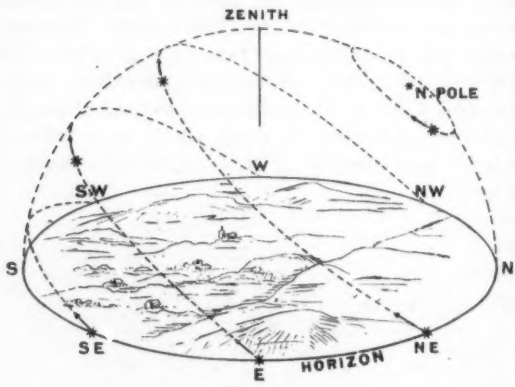


FIG. 4.

The lower the altitude of a star is the better for marching, so long as it can be clearly seen. At or near the zenith a star would be quite useless for giving direction.

It is clear that wherever a man is, except near the North Pole, if he can see the Pole Star he never need go hopelessly wrong in his direction, since if he has this in front of him he must be facing true north, his back is towards the south, and if he stretches out his arms at right angles his right hand will point east and his left hand west. Any other direction can be roughly found from these, and if more convenient the face may be turned towards the east or west by placing the outstretched arms north and south.

When the Pole Star is obscured there are rough ways of finding the north direction, of which those most frequently given in books are: (1) Follow the direction of the line of the two pointers (α and β Ursæ Majoris) of the Great Bear for about five times the distance these stars are apart, and the position indicated will be true north. (2) Imagine a line connecting the "W"-like stars in Cassiopeia with the pointers of the

Great Bear, and halfway across will be the north direction. (3) When the pointers are vertically above one another they are practically due north. (4) When Ursa Major is below the horizon the approximate direction of true north can be found by supposing a line drawn from α Andromedæ (Alpheratz) to β Cassiopeia, and producing it beyond the latter for a distance that these two stars are apart.

There are similar rough ways of finding the south direction, such as (1) suppose a line joining the two stars of the Southern Cross which are farthest apart and the point on the continuation of this line situated four and a half times beyond the brightest star the distance that the two stars are apart will be nearly due south; (2) imagine a line connecting β

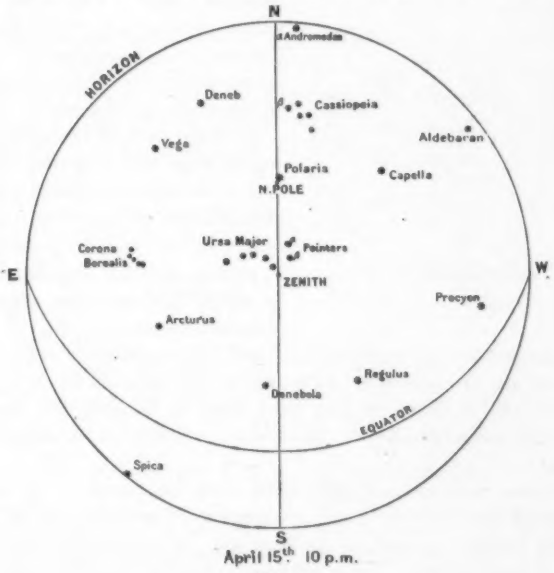


FIG. 5.

Centauri and Achernar, and the central point of this line will be nearly the true south direction.

These rules for finding bearings are all simple enough, and although they are only rough and approximate they have for many years proved of the greatest service to night travellers in the wild, who have had no compass or other instrument of any kind with them. Indeed in military operations too many a man has found them invaluable to him, as I have heard only just recently. But there are times, such as when the northern heavens are clouded over, when they are not available. Besides, what is wanted is a star in something like the direction of the march, and the problem is how to make use of any bright star for the purpose of marching.

The recent efforts of those who have taken the matter up have been specially directed to finding a simple method of doing this.

In Fig. 6 suppose NESW to be the horizon, and let NS be the true north and south line, or the meridian. Z will be the zenith, and P the north pole. Now suppose the star to be in the position indicated by ✱. Then A✱ will be the star's altitude, ✱Z its zenith distance, ZP the co.-lat. of the place, and P✱ the star's polar distance. The curved line P✱B will be the hour-circle passing through the star, the angle ZP✱ will be the hour angle of the star, or its distance in time from the meridian, and the angle PZA the star's true bearing or azimuth, as it is called, which it is required to find. This is one of the angles of the spherical triangle PZ✱, and in all accurate survey work is computed by the ordinary formulæ of spherical trigonometry.

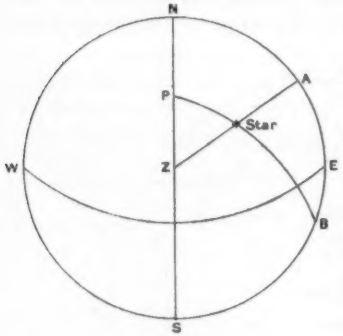


FIG. 6.

For the purpose of rapid marching by stars it is absurd to suppose that a man is going through a lengthy computation of spherical triangles before he can find his bearing, and so various attempts have been made to supply him with this angle with sufficient accuracy for use.

For any latitude the angle can be found by two different ways, that is, (1) by knowing the hour-angle ZP✱, which can be found for any time of the night, and so comes to the same thing as knowing the time; or (2) from the measured altitude A✱, which gives the zenith distance ✱Z of the star.

The tables in Colonel Tilney's little book are based on the first of these methods, and give for every five degrees of latitude from 40° N. to 55° N. the bearings of the most suitable stars for night marching for the first day of every month. These bearings are given for every hour of the night from 8 p.m. to 5 p.m., and are to the nearest five degrees; that is, none of them is likely to be in error by more than about 2°. He has also published similar tables for star marching in India, which have been of great service. A specimen of one of the pages of these tables will be found below. Clear examples are given to show how to use the tables, and there are star-maps at the end.

Colonel Tilney has, I understand, still further improved his methods quite recently, and I hope he will tell us something about this later.

There have been, of course, for years past, sets of Azimuth Tables obtainable for the use of navigators, but these are not suitable for rapid star marching.

Mr. J. Dundas White, M.P., who is an authority on matters connected

with navigation, has turned his attention to this subject of marching by stars, and at the present time has an interesting and useful little booklet in the press, which also gives tables of star bearings for different latitudes. It will, I hope, soon be published.

One advantage of the time method is that no special instrument is required, and if a man has a watch he can mark out the bearings on a card, or make a note of them before he starts, as I shall show presently, and then march by them. Another advantage is that, provided the altitude is not too high, stars near the meridian can be used as well as those at a distance from it, which is frequently not the case with the altitude method. However, it is important to remember that the bearings are

1st April. **LATITUDE** **50° N.** **1st April.**

Time	8 p.m.	9 p.m.	10 p.m.	11 p.m.	12 mid.	1 a.m.	2 a.m.	3 a.m.	4 a.m.	5 a.m.	Remarks.
REGULUS	145 E f N	170 E f N	170 W f N	145 W f N	125 W f N	110 W f N	100 W f N	85 W f N	Set 75 W f N		For Westerly Stars—see ALDEBARAN, SIRIUS, CAPELLA, PROCYON, CASTOR.
SPICA	Rising 110 E f N	M P 125 E f N	135 E f N	150 E f N	165 E f N	175 W f N	160 W f N	145 W f N	130 W f N	120 W f N	
ARCTURUS	80 E f N	E	105 E f N	120 E f N	M 140 E f N	P 165 E f N	170 W f N	145 W f N	125 W f N	110 W f N	
ANTARES						M P Rising 145 E f N	155 E f N	170 S	Almost S 165 W f N		
VEGA	Rising 25 E f N	35 E f N	45 E f N	55 E f N	60 E f N	70 E f N	80 E f N	E	105 E f N	T H	
ALTAIR						Rising 80 E f N	95 E f N	105 E f N	120 E f N.	135 E f N	

LATITUDE **55° N.**

REGULUS	150 E f N	170 E f N	170 W f N	150 W f N	130 W f N	115 W f N	100 W f N	W	Setting 75 W f N		
SPICA		M P 125 E f N	140 E f N	155 E f N	170 E f N	175 W f N	160 W f N	140 W f N	130 W f N	120 W f N	
ARCTURUS	85 E f N	95 E f N	110 E f N	125 E f N	M 145 E f N	P 165 E f N	170 W f N	150 W f N	130 W f N	110 W f N	
ANTARES						M P Rising 155 E f N	170 E f N		Almost S 165 W f N		
VEGA	Rising 25 E f N	35 E f N	45 E f N	55 E f N	65 E f N	75 E f N	85 E f N	100 E f N	115 E f N	T H	
ALTAIR						Rising 85 E f N	95 E f N	110 E f N	125 E f N	140 E f N	

Remember Stars rise 2 hours earlier every month — which is the same as half an hour earlier every week

Specimen Page of Colonel W. A. Tilney's Star Tables.

given in Colonel Tilney's tables for the local mean time, and this must therefore be approximately known. Still there is but little difficulty about this; for instance, if a man arrives at the front in France with a watch showing Greenwich mean time, all he has to do is to add the approximate longitude in time (about ten minutes), or put his watch on by this amount.

Attempts have been made by several persons interested to formulate general instructions for star marching applicable to a considerable extent of latitude, such as the whole of Central Europe, but many of these rules given are too rough and approximate to be of any use at all, and might mislead rather than help one to arrive at the desired destination. For instance, such a statement as "all stars rise in the east and set in the

west," which I have more than once seen in books purporting to be guides to star marching, is most misleading, for most stars do not rise in the east at all, and if a man is facing a star that is rising in the north-east, his left arm will be 45° to the west of north.

Then again as regards the limits of latitude, true it is not necessary to have a separate table for every degree, but considerable error will arise if the same table is used for many degrees.

As I could not readily obtain the information with sufficient accuracy for the purpose from published tables, I worked out the other day, in view of this paper, what the difference in bearing would be for a difference in latitude of 5°, and I give these figures below :—

CHANGE IN BEARING DUE TO 5° CHANGE IN LATITUDE (N. LAT. 50° TO 55°).

Hour angle.	N. Declination 70°.	35°.	0°.	10° S. Declination.
0h	0°	0°	0°	0°
3h	5°·35	6°·21	1°·87	1°·17
6h	2°·92	2°·35	0°	0°·62

From this it is clear that there is a considerable change in the bearings at certain hour angles if there is any great change in the latitude, and for them to be of any real value, even for such methods as we are dealing with, the same figures cannot be used without introducing considerable error for more than about 2° or so of latitude.

There is often a tendency to confuse the hour angle of a heavenly body with its azimuth or bearing, and to consider the change in these as the same. Not long ago a book was published in which appeared a statement which showed that the two were hopelessly mixed in the author's mind.

In this connection it may be interesting to see what sort of a change does actually take place in the bearing of stars for any interval of time, so I have worked out a table for lat. 50° N. for a change in time of 20m with different declinations, those selected being 70° N., 35° N., 0°, and 10° S. The changes in bearing are for the changes in hour angle of 0h to 0h 20m, 3h to 3h 20m, and 6h to 6h 20m.

DIFFERENCE OF BEARING OF STARS FOR A DIFFERENCE IN HOUR ANGLE OF 20m. (LAT. 50° N.).

Hour angles.	0h to 0h 20m.	3h to 3h 20m.	6h to 6h 20m.
Declination 70° N. ...	4°·97	1°·0	2°·03
,, 35° N. ...	16°·77	4°·73	3°·18
,, 0°	6°·51	4°·55	below horizon
,, 10° S. ...	5°·68	4°·48	,, ,,

From this it is clear that the change in the bearing is not at all the same thing as the change in time, nor do they vary in the same proportion.

Since by all methods of finding the bearings that depend upon the time or hour angle it is necessary to carry a watch, there seems no reason why the watch itself should not be turned into a compass, and if it could be arranged so that at any time when the hour hand is pointed at a known star, a definite line on the dial or marks on the dial automatically indicates the true north and south line, a useful star compass would be made from an ordinary watch without interfering with the latter. In fact it ought to be possible to use a watch as a star compass by some simple addition that could be easily and inexpensively fitted to one of ordinary make.

There is already the well-known way of using a watch for finding approximately the north and south line by the sun, and my idea was to make some arrangement so that the same kind of thing could be done by using certain of the brightest stars.

The result of my endeavours and experiments in this direction will be found in the "Night Marching Watch" (Fig. 7), which was described in the *Geographical Journal* for April 1913.

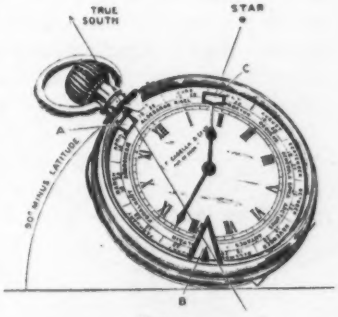


FIG. 7.

It would take too long now to give a detailed explanation, but briefly the scheme consists of adding two movable concentric circles to the dial of the watch, outside the hour circle, a luminous point to the hour hand, and two other luminous marks of radium paint to the circles. By a simple setting of the circles for a suitable star, the names of which are given on one of the circles, it is so arranged that, when the hour hand with the luminous point is directed towards the star, and the watch held roughly at an angle equal to the latitude of the place, the other two luminous marks indicate the north and south line, or can be set on to any bearing upon which it is desired to march.

This compass watch has been throughly tested and found useful; one traveller got the navigating officer on board the ship in which he was travelling to America to compare it during the voyage with the bearings given by the ship's compass, of course making allowance for the variation, and he wrote afterwards to tell me that the results were most satisfactory.

The second way of obtaining the true bearing of a star is from its altitude above the horizon line. In all accurate survey work this altitude is carefully measured with a theodolite and the bearing or azimuth (the angle PZ$\star$, Fig. 6) computed by spherical trigonometry. Now a soldier

on a night march is not going to carry a theodolite about with him, but if he can take a rough shot at the star even with a small clinometer, giving the altitude to the nearest degree, there is no reason why he should not obtain a bearing that will be quite useful for marching on, except when the star is close to the meridian; and this method would have the advantage of doing away with the necessity of carrying a watch, since no time is required.

A short time ago I looked into this matter to see what could be done, with a view to making some simple clinometer that would give the bearings of stars corresponding to any altitudes, instead of the altitude itself as is the case with an ordinary clinometer, and I came to the conclusion that it is quite possible to do so. Fig. 8 shows a clinometer of this kind.

I cut a semicircular piece of card, and marked out, for lat. 50°, the true bearings from the north point of the horizon of Altair on one side and Vega on the other, corresponding with the angles of altitude, so that when a rough altitude is measured in the ordinary way, the silk, at the end of which is a bead to serve as a plumb-bob, cuts the bearing of the star at the time. The bearings can, if desired, be marked with luminous paint so that they could be read at night. I have tested this simple little arrangement and found it very fairly accurate. As I have shown, it could be used within a degree or two on either side of the latitude of 50° N., and so would serve for the whole of the British field of operation in France. Clinometers of this kind could be made of celluloid or any other suitable material at insignificant expense, and about half a dozen of them, with two stars on each, would be all that is required. The number could, of course, be reduced by having two concentric arcs on each side, so that one protractor would serve for four stars, as shown in Fig. 8. Any ordinary clinometer could be adapted.

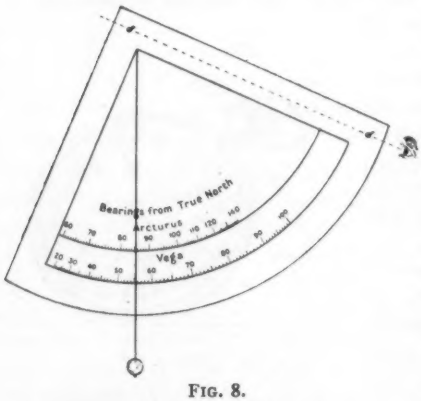


FIG. 8.

In order to show what sort of error is likely to be produced in the bearing by taking such rough altitudes as here referred to I have computed the approximate changes produced in the bearing by a supposed error of 2° in the altitude, which is about twice as large as may reasonably be expected, since it is a very bad clinometer that will not give altitudes true to one degree. However, taking the error at 2° the following are the results :—

DIFFERENCES IN BEARING DUE TO A SUPPOSED ERROR OF 2° IN THE MEASURED ALTITUDE (LAT. 50° N.).

	Approx. hour angles.			
	0^h	1^h	3^h	6^h
Declination 70° N. ...	Indefinitely large	17°·7	2°·7	1°·1
,, 35° N. ...	,,	11°·7	3°·1	2°·1
,, 0	,,	5°·6	3°·8	2°·4
,, 10° S. ...	,,	8°·1	3°·8	Star below horizon

From this it is clear that to be sufficiently accurate the altitudes must not be taken when the hour angles are very small, and the only safe rule is to take them when the stars are at a considerable distance from the meridian. Stars with a high declination, such as Vega, are in this latitude much too near the zenith for finding directions when near the meridian, so in any case they would not be used. It is easy to see if the star is east or west of the meridian by noting whether their altitudes are getting higher or lower as time goes on.

Soon after I had my attention specially turned to the importance of using stars for night marching I designed what is called the "Astronomical Compass," which was described in the *Geographical Journal* for December 1908. As this little instrument has now been used a good deal in various parts of the world, probably some of you are acquainted with it, so I shall not detain you by attempting to give a detailed description of it here. However, I will briefly explain how it is used for finding star bearings and marching purposes. It has other uses as well, such as giving the time, but I will only deal with it now as a star compass.

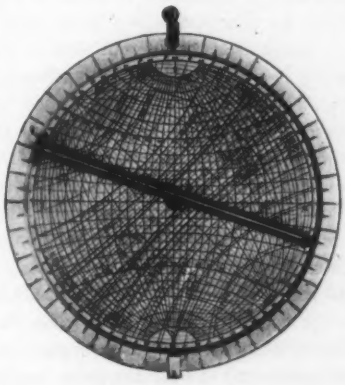


FIG. 9.

The instrument (Fig. 9) consists of two discs upon each of which is a projection of a hemisphere drawn on the plane of the meridian. One of the discs shows, in black, parallels of declination of the principal stars with hour circles, while the other, the upper one, is transparent, and shows in red, curves of altitude and azimuth. The two discs are centred on a pivot on which they can be revolved, and the transparent one is weighted at the lower part to keep it vertical. Through the pivot passes a pin carrying a sight-rule on the front of the transparent disc, and fixed to the handle

at the back. When the instrument is used for finding star bearings, the north pole of the black declination circle is first set to the red number on the transparent disc at an angle equal to the latitude of the place; then allowing the discs to swing freely, clamped together, a rough altitude of the star is taken by means of the sight-rule. The red altitude circle on the transparent disc, indicated by the pointer at one end of the sight-rule, is now followed across the disc until it intersects the black curve of declination of the star observed, seen through the transparent disc, and then the red longitudinal curve passing through the point of intersection gives the bearing of the star. The compass can be also used for marching by setting the bearing on the circumference of the disc, and then placing it horizontal, and pointing the sight-rule at the star. When this is done the north and south line will be shown by the central red arrow on the disc. Luminous paint renders it possible to see the circles and marks at night. With this instrument altitudes and bearings can be read to the nearest degree and no tables whatever are required. It can also be used for finding the bearing when the hour angle is given, and many have told me that it has proved of great service to them, although of course too much must not be expected from any arrangement of this sort.

It is not necessary that the instrument itself should be carried on a rapid march, as the bearings of a suitable star can be taken off for the required times and noted down beforehand.

The greater part of this paper has so far been taken up with different methods of finding the bearings of stars at any time, and now we must pass on to the practical part of using these bearings in marching.

There are two different ways of using stars in night marching, and that which is generally given in handbooks is to treat them as marks to indicate the bearings previously ascertained by means of a prismatic compass, and march on them just as one would use distant hilltops or any other prominent terrestrial objects for the purpose in the daytime. This is simple enough, and does not even necessitate a knowledge of the name of the star. It is important to be sure that a star at a suitable altitude and position in the heavens is used, and that there is no mistaking it for another after starting on the march. It should be as near the direction of the route as possible, and preferably a few degrees to the east of the route at the commencement to allow for its movement, which might take it inconveniently far away as time goes on. The time during which a star may be considered to have the same bearing depends upon its position, but as a rule it is safe to take it as about 15 minutes or even longer under favourable conditions. There is no need to have the star right on the line of march, as it is easy to measure with sufficient accuracy the number of degrees round the horizon between a vertical line under the star and the required direction, provided the angle is not very large. The angle subtended by the length of the ordinary easy span from the end of the thumb to that of the middle finger may be taken as 15°, so if a man has no other

means of measuring an angle round the horizon he can stretch out his arm and roughly span out the required number of degrees in this way. It will be convenient to know the length of various parts of the rifle in inches or to carry a stick marked in inches, for then when this is held in the centre by the clenched fist at arm's length, the angles subtended are easily known and committed to memory from the following table :—

2	inches	may	be	considered	to	subtend	an angle of	5 degrees
4	"	"	"	"	"	"	10	"
6	"	"	"	"	"	"	15	"
8	"	"	"	"	"	"	20	"
10	"	"	"	"	"	"	25	"
12	"	"	"	"	"	"	30	"

Clear and concise instructions for combination star and compass marching are given in the official Manual of Map Reading and Field Sketching, and in other books, so nothing more need be said here.

It is important in this and in any other system of star marching to make good use of features such as junctions of streams, lakes, hills, etc., as they are approached sufficiently close to become visible to check the bearings and distances, just as a navigator verifies his position at sea whenever an opportunity occurs by headlands, soundings, and any means of the kind available.

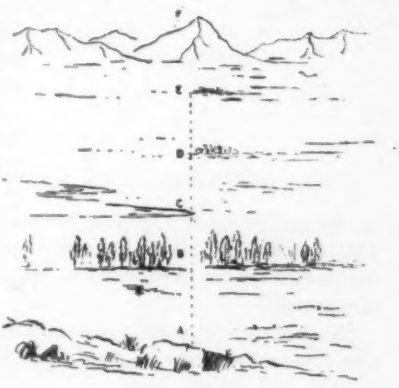


FIG. 10.

A very good example of a star march combined with or without a compass is given in Major H. Maclear's useful little booklet on 'Night-Marching by the Stars' which appeared last year, and which I was asked by the author to look through when in proof form. I have ventured to make a slide from the example which I will now show on the screen (Fig. 10).

It is desired to march from A to E, a fortified village which has to be surprised by night. The line has been reconnoitred by day, the compass bearing of E taken, and the positions of prominent features noted down. At night when the march is commenced a suitable star is selected near the line of march, or a little to the east of it, and the march commenced. The distance between the points have been ascertained roughly from some sketch-map or other information, so the position at any time during the march is fairly well known, and can be checked by the land features as they are reached.

By the second method of star marching no magnetic compass is used at all. The bearings of the stars for suitable times during which the march is to take place are taken out from Colonel Tilney's tables, by the astronomical compass or some other means, and are jotted down, with the times and the route regulated accordingly, as previously shown.

Sometimes it is convenient to construct a bearing card like that shown in Fig. 11 before starting on the march. The lines can be marked by luminous paint, or by sticking pins on the various lines. All that is necessary then is to hold the card horizontal and to place the line of star bearing for any time in the direction of or vertically under the star, and march on the bold line indicating the direction of the route.

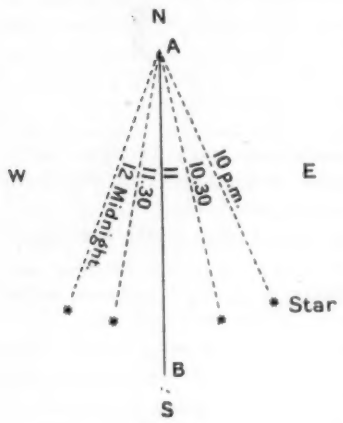


FIG. 11.

So far the route has been supposed to follow a straight line, but it is hardly likely to do this for any length of time, so I will close by giving an example of a march with changing directions and bearings.

Let it be supposed that a party has to march at night from A to B (Fig. 12). Before starting the route to be taken is roughly sketched out on the best available map, and the true bearings from the south measured with a protractor. If the ground is entirely unknown, the route must be reconnoitred in the daytime from compass bearings and time and a route map drawn.

Next the star's bearings are taken from the tables as before, or otherwise obtained as described for suitable times, which are here 10^h, 10^h 15^m, 10^h 30^m, and 10^h 45^m.

These star bearings are plotted out as shown on the example, and together with the bearings of different sections of the route, give the bearings to be followed during the march. For instance, from 10^h, when the march commences, to 10.15, the 10 o'clock bearing is followed; that s the star is kept 14° to the left of the route; from 10.15 to 10.30 the 10.15 bearing is followed, and the star kept 28° to the right of the route, and so on.

When the march is actually taking place all that is necessary is to have a note of the bearings to be followed at different times, and change them as these times arrive. A watch is, of course, necessary to give the times. If the bearings and times are not many they could be committed to memory beforehand. The bearings are taken at quarter-hour intervals, which would be near enough for the purpose, as the differences are only

about 3° or 3½°. If the difference had been greater or the bearings had been taken out for longer intervals, it would have been well to have used the bearing of the star for the time midway between the times of the commencement and termination of the various sections of the route, which would have helped to balance the error. The following table gives the

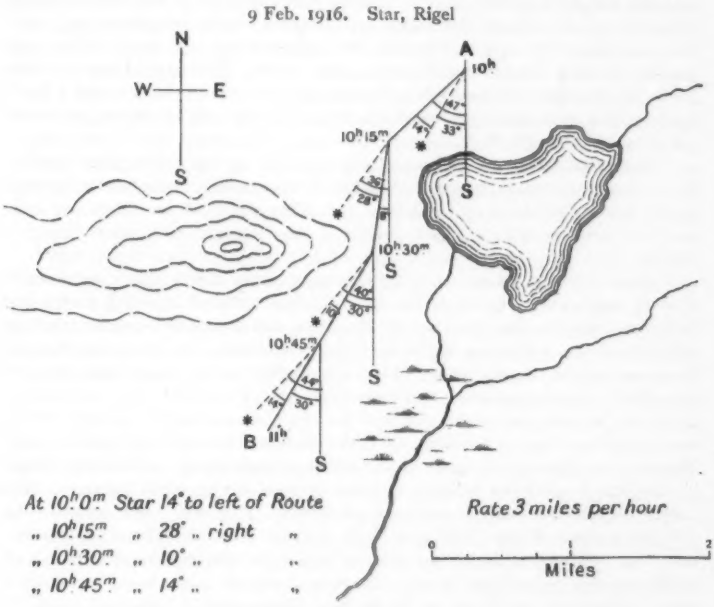


FIG. 12.

error in yards on either one side or other of the correct point for various degrees of error in bearing after a distance of 2 miles.

1°	error =	61·2 yards.
2°	„	= 122·9 „
3°	„	= 184·4 „
4°	„	= 246·1 „
5°	„	= 307·9 „

By estimating the rate of march, the times when each change of the route is arrived at can of course be noted down beforehand. In this example the rate is supposed to be 3 miles per hour.

Lieut. HOLROYD: What has chiefly struck me during Mr. Reeves' lecture is that probably not one officer in twelve knows his stars. It was only last autumn that I began to learn my stars. I thought it might be as well to spend a few weeks or months of convalescence in finding out the principal stars; it

took me less than a week. One's first notion is that the stars are a big and complicated subject, but if people realized how simple it is to learn the general shape of the constellations, many more would do it.

The method by which I taught myself was to get a star-map and a piece of brown paper and four sizes of pins, and prick holes in the paper to represent the stars according to their different magnitudes and relative positions; thus I mapped out the northern sky. I started with the pole in the centre, and as I got out to the edge of the paper, gradually the shape became wrong, and I had to enlarge the spaces between the constellations. It took me a single evening to prick out the constellations, that is the chief ones, down to a little south of the Equator; and when I went out into the night I found I knew them. Held up to the light, the dark paper pierced with pinholes gave much the effect of the night sky.

I think that would be the best way to get over the great difficulty, which is to get people to learn the general shape of the constellations, just as the best way to learn the shape of a country is to draw a map of it. Once you have got those first few stars, the rest, thanks to Mr. Reeves and Colonel Tilney, is simple.

Colonel TILNEY: Some time ago I read a paper before the Royal Society of Arts announcing the perfection of an easy method of enabling troops and individual men to find their way by the stars, and discussing the far-reaching influence of the system on night warfare. A knowledge of the position of the brightest stars in the sky brings about a revolution in the possibilities of night movement and operations. Fourteen years ago I foresaw that most of the important fighting in modern war must be at night, and that if we could devise some simple method of teaching all ranks to know their way at night it would improve the fighting efficiency of the army a hundredfold. The object I had in view was to solve the problem of knowing your way at night without a map, watch, compass, or any instrument whatever. This has been attained by the publication of the 'Soldier's Night Guide' (Gale & Polden, Aldershot) price 3*d*., editions of which are now published for almost all latitudes, which enables troops to get their general direction from the heavens. For accurate work, 'Marching or Flying by Night, with Time-table of Direction Stars,' is now complete for most countries of the world (Hugh Rees, 5, Regent Street, London, price 1*s*.).

I little thought that we should be able to solve the problem so satisfactorily, and I take this opportunity of expressing my deep gratitude to Mr. Reeves for his help and kindness; nor must I forget Captain Blackburne, the nautical adviser to the New Zealand Government, who was always ready to assist me in India. After many failures and vicissitudes we have conquered the night and thereby revolutionized warfare. To many of you this may appear to be an exaggeration, but I have received reports from many parts of the country, as well as from abroad, of the far-reaching influence this knowledge of the stars must have on almost every branch of the service.

Mr. A. R. HINKS: I should like to accentuate in the first place what Mr. Reeves has said: that the method of night marching by stars should be looked upon as only one of several methods available, and especially as one which is not always available. From that point of view I cannot help thinking that Colonel Tilney has perhaps exaggerated the merits of night marching by stars, because it will be seen that the first time one wants to go on a night march on a really favourable night—when there are no stars—he will have to fall back upon our old friend the magnetic compass. There are a very large number of

methods of employing the stars and the compass to set one another off—of employing the stars to enable you to use your compass, to check your compass, even to march on if you lose or break your compass. But the man who will understand how to make the best use of these is the man who knows the many different methods and the way they are involved, so that if one fails he can fall back on another. It seems to me a pity to lay too much emphasis on night marching by stars as a great discovery, for it is nothing new, though it may not have been enough practised. At any rate some ten years ago the late Captain Bertrand Stewart, who was well known to many of you as a very keen yeomanry officer, and who at that time was bringing out the "Active Service Pocket-Book," wrote to my old chief and asked if he could advise him on methods of marching by the sun and the stars. The matter was handed over to me, and we invented "star compasses" and "sun compasses," which are to be found in that book. I am not at all sure that these star compasses and sun compasses have any particular merit. There is nothing particularly new in the idea, and there are fifty ways of doing the thing, some of which Mr. Reeves has described in his interesting paper.

There is one thing that Captain Stewart's book tried to do, very roughly, that has not generally been done, and that is give an indication how to use the moon for marching on. The moon is the most erratic body in the sky, and not only moves very irregularly in its orbit, but is inclined to the ecliptic, and, generally speaking, it is not very easy to get any useful sort of simple rules. On the other hand, it would be extremely valuable to use. There are many nights when one can see the moon, but not the stars, through fog or broken cloud. I would like to suggest that it would be quite easy with some such instrument as Mr. Reeves' Astronomical Compass to plot out in advance the bearings of the moon for any particular nights and times. That is a thing that, of course, you would not expect a private soldier to do; but might it not be considered as a legitimate part of staff work, whenever there was any important operation on hand? The preparation of a little table of the bearing of the moon for every quarter of an hour is not a complicated matter.

I should like to say a word about the general accuracy of these methods of marching by stars. It has struck me while listening to Mr. Reeves, and more forcibly while Colonel Tilney was speaking, that one might very legitimately aim at considerably greater accuracy than they have provided. When I was at Cambridge I was interested in the work of the Officers' Training Corps, and used to arrange marching competitions, which consisted of the simple exercise of starting teams to march straight across country upon a given bearing for 2 or 3 miles. A challenge cup was given to the company team which kept this bearing best. This march was done, of course, with the luminous prismatic compass of the old pattern, and I was always interested to work out what was the probable error of a march under such conditions. Experience of a considerable number of competitions showed that the probable error was $1\frac{1}{2}°$. If you started eight teams marching upon a given compass bearing, the probability was that four would be inside $1\frac{1}{2}°$ of the truth and four outside it. That suggests that if you are going to use your stars as aids to compass marching you must not be quite so tolerant of their motion in azimuth as Colonel Tilney would be, because in fifteen or twenty minutes a star may move 4° or 5° or more. You should bear in mind that the star is moving at the rate of a degree in so many minutes; or at any rate allow for the gradual drift of the star if you are marching anywhere towards north or south. East and west it is less important. It is worth while, I think, to aim at a higher degree of

accuracy than Colonel Tilney aims at. He said, for example, that on the Tigris the stars rise vertically, so they maintain each its constant azimuth. That must not be taken too literally. They will rise at a slope of 25° to the vertical, and so will have a considerable motion in azimuth. I should like to see tables such as those of Colonel Tilney given to the nearest degree instead of to the nearest 5°. It would encourage people to aim at an accuracy that is by no means outside what can be achieved.

Captain L. A. W. BROOKS, R.F.A.: I understood from the lecturer this afternoon that if the arm is held out at full length the span of the fingers would be about 15°. Is that accurate? We have always been taught that the calibration of the "span of the fingers" when the arm is held at arm's length is 19°. The difference in traversing 4 miles would, of course, give an error of 246 yards, which is more than ten per cent., and it would be quite obvious to any one that after a march of say 15 to 20 miles at night-time the approximate difference would be very greatly increased in ratio to the distance covered. I should like to ask if the calibration approximates more closely to 19° than 15°.

Mr. REEVES: The angle subtended by the span at arm's length must, of course, depend upon the length of a man's arm and the size of his hand, but as an average it may, I think, be taken as about 15°, on the supposition that the length of an easy natural span from the tip of the thumb to that of the middle finger is 6 inches. It could certainly be stretched to a greater length. From the tip of the thumb to that of the little finger would subtend a larger angle, say about 18° or 19°. These are the figures I have seen in books, and from trial I have found them about right.

Dr. J. W. EVANS: I must congratulate Mr. Reeves in giving us another example of his ingenuity and originality. There is, however, one point he did not bring before us, which is that the choice of the method to be employed in determining the azimuth or bearing of a star must depend very largely on the latitude. He obtains the azimuth either from the hour angle or the altitude. In high latitudes the altitude cannot be employed, because it varies very little; the observer must therefore resort to the hour angle. Near the equator, on the other hand, the altitude changes rapidly, and a considerable alteration in altitude is accompanied by only a small variation in the bearing. Consequently the simpler method in which the bearing is deduced from the altitude is to be preferred.

There is another method which might, I think, prove convenient except near the poles. Instead of taking the altitude of one star, the apparent inclination of the imaginary line joining two neighbouring stars might be taken. Two very simple examples will explain the principle. At a latitude of 10° to 15° south, wherever the Great Bear appears at certain times above the horizon but the pole star is not visible, we know that when the pointers are vertical they are due north of the observer. Again, if in the north of India α and β Centauri are seen in a horizontal position, they will be situated due south.

There would be no difficulty in constructing a table for any particular latitude showing the relation of the inclination of two stars to the azimuth of one of them.

[*Note.*—The azimuths and co-altitudes of both stars will first be calculated from the co-latitude and their co-declinations and hour angles. The apparent inclination of the line joining them is then given by the formula—

$$\tan \kappa = \frac{\cot \beta_1 - \cot \beta_2}{2 \sin \frac{1}{2}(\alpha_1 - \alpha_2)} = \frac{-\sin (\beta_1 - \beta_2)}{2 \sin \beta_1 \sin \beta_2 \sin \frac{1}{2}(\alpha_1 - \alpha_2)}$$

where κ = the inclination required; α_1, α_2 the azimuth, and β_1, β_2 the co-altitudes of the stars. It is obvious that tan κ will be + when the line joining the stars slopes upwards from the first to the second, provided they are numbered in the direction in which the azimuth is measured.]

The principle of the clinometer described by Mr. Reeves might be utilized for this method. The card would have concentric circles drawn upon it in exactly the same manner, but the graduations showing the bearing of one of the stars would be determined not by the altitude of that star but by the apparent inclination of the two stars. Such a card would be easier to use. Mr. Reeves, in his altitude method, looks along the edge of the card at the star, but I do not know exactly how he reads the position of the plumb-line at the same time. Probably he gets an assistant to do it. If, however, an observer determines the inclination of two stars by holding it so that they seem to lie on its upper edge, he can simultaneously observe the position of the plumb-line.

Mr. REEVES: The method of finding the azimuth by the inclination of two stars as suggested by Dr. Evans is decidedly interesting, and I should like to see clinometers such as he suggests constructed for different latitudes, as under suitable conditions they would doubtless be useful. Of course, it would mean that the two special stars must be visible at the same time instead of one only, and with our cloudy skies this might frequently be impossible. I hardly think that such a clinometer would be easier to use than one depending upon the altitude of a single star, and I have found that the whole operation of obtaining the azimuth with the latter only occupies a few seconds. There is no difficulty in reading the azimuth off the scale. When the star is sighted, and the thread with the plumb-bob is steady, by a quick turn of the clinometer over to the side opposite to that on which the thread hangs, the weight at the end holds the thread firm until the azimuth can be read. Many suitable clamping arrangements could be suggested, and most of those already in use in ordinary clinometers would serve the purpose quite well.

Colonel TILNEY: May I just say a few words in reply to what Mr. Hinks has said? All that I did wish to suggest was that the natural compass in the heavens would be of the greatest possible utility to men fighting at night. I want also to say to Mr. Hinks that what I aimed to start with was to make all men, not only an officer with a compass, know their way. I believe that the key to success in night warfare is for all ranks to know their way at night. The only manner in which this end can be attained is to teach the rank and file, who have no compasses, how to read the sky. It has been proved beyond a shadow of doubt that if men get into the habit of observing their direction by the stars, they instinctively acquire a sense of direction, so that they find their way by terrestrial objects when no stars are visible. Once you instil into troops this sense of direction most difficulties connected with night operations are removed: (i.) The men are confident and self-reliant; (ii.) they will not fire and dig trenches in the wrong direction; (iii.) all communications will be much facilitated; (iv.) in night attacks or retirements, all ranks will know the direction of advance or retirement; (v.) slightly wounded men, able to walk, know their way back to the dressing station; (vi.) it was proved in India that troops can be manœuvred with ease, rapidity, and accuracy on a starlight night. Many other obvious advantages might be given.

With regard to Mr. Hinks' criticism that we should try for a greater degree of accuracy, I would refer him to our first effort to solve this problem which was published in 1909, 'Rapid Night Marching made easy' (Stanford, Long Acre, London, price 2*s.* 6*d.*).

The systems explained therein enabled you to get any star's bearing accurately for any hour or latitude ; it was thoroughly tested in India, South Africa, and at home, and except for artillery purposes this extreme accuracy was found to be altogether unnecessary. As Mr. Reeves points out, the present tables can be read to within 2° of accuracy for any hour of the night.

The PRESIDENT: I am afraid our subject to-night is not one on which I can make any serious contribution to knowledge. In my travels my regards have been rather earthly than heavenly. One has, perhaps, been too much inclined to look upon star-gazing as a romantic pursuit. It is a good thing that we should be taught to appreciate its practical uses. The reason why we have been so slow to do so may be that in this country we live in such a misty climate, and it is practically only one night in three that you have any stars to steer by. I must confess that I have never steered my course by the stars, but I was a little surprised to hear marching by stars spoken of as being novel. It has surely long been the practice among "simple people." In every new discovery, or new form of invention, when we look back we find there are predecessors in some rudimentary form. There were balloons in the skies before there were Zeppelins. We have heard to-night of a method which ensures a practical advance, and may be extremely useful particularly to armies who have to fight, happily or unhappily, under the burning suns and the brilliant stars of Eastern lands. I am sure you will agree with me in wishing to thank Mr. Reeves warmly for the trouble he has taken, for the excellent diagrams he has shown, and for the clear way in which he has put this matter before us.

Note.—In subsequent conversation with Colonel Tilney I have realized that his aims are different from what I had supposed when he spoke. He is not really concerned with training troops to march as accurately as possible by the stars, but has the simpler and no doubt exceedingly important object of showing every man how he can, in a rough and ready way, learn the points of the compass and so keep his direction at night. This is of course quite a different matter from what Mr. Reeves and I were speaking of. It is doubtless quite true that the average man enlisted into the army, often a town dweller and always accustomed to move about on known roads, has little or no idea of keeping the points of the compass in his head.

I am still disposed to think that Colonel Tilney would do well in future editions of his tables to give the azimuth to the nearest degree, so that the motions of the stars in azimuth at different times at night may be better represented. It is somewhat confusing to any one who wishes to go beyond the most elementary use of the stars to find them as represented as moving perhaps 10° in azimuth in one period of two hours, and 0° in the next period.—A. R. H.

THE MIGRATIONS OF EARLY CULTURE.

The Migrations of Early Culture.— Prof. Grafton Elliot Smith. Manchester University Press. Pp. vii., 143. 3*s.* 6*d.*

The Influence of Ancient Egyptian Civilization in the East and in America.— G. Elliot Smith. Reprinted from the *Bulletin* of the John Rylands Library, January—March 1916.

THE work of Prof. Elliot Smith to be here noticed should be of especial interest to geographers in that it brings their science into intimate relations with anthropology. The current doctrine, according to which the similarities of human culture found throughout the world have been the result of processes of independent evolution, has made geographical factors of little interest to the anthropologist. It is true that certain writers have attempted to derive varieties of culture from the nature of the environment in which these varieties are now found, but these attempts have been so obviously futile that they have only served to obscure the very real connection which exists between human culture and its geographical environment.

Elliot Smith believes that human inventions have been made only once. He regards inventiveness and originality as characters so exceptional that very rarely, if ever, has any discovery been made wholly independently in two or more places. Whenever he finds close similarity of custom in different parts of the world he concludes that the custom came into being in some one locality and was carried thence to its other centres of distribution by the migrations of mankind.

For some years Elliot Smith has been demonstrating the single origin of megalithic monuments, but the starting point of his book on the migrations of early culture was the discovery made during a visit to Australia that the natives of Torres Straits mummified their dead by processes resembling those of a certain period of Egyptian history. These processes are alike in so many points of detail as to leave little, if any, room for doubt that the practice of mummification was transmitted from one place to the other.

A study of the distribution of mummification and of certain other elements of human culture was then made in conjunction with Mr. W. J. Perry. This study showed that the distribution of the practice of mummification corresponded closely with that of megalithic monuments, sun-cult, sacred kingship, circumcision or incision, tattooing, piercing and distension of the ear-lobe, deformation of the head, irrigation and terracé-cultivation, the svastika, the boomerang, and many other features of culture, including possibly the art of writing. Moreover, Mr. Perry has shown (*Proc. Manchester Lit. and Phil. Soc.*, 1916, 60, Part I.) that in many parts of the world this distribution agrees with that of old mine-workings and with the occurrence of precious stones, pearls, amber, or other objects which

have long been highly valued by mankind. The carriage of the complex group of customs associated with mummification seems to have been determined by a cause which is still the most potent incentive to migration, the pursuit of wealth.

The mass of evidence brought forward by Prof. Elliot Smith and Mr. Perry, together with that collected by other workers, is already sufficient to show that transmission by means of migration has been the main factor in the production of the similarities of human culture throughout the world. The subject has now reached a stage in which, the main principle having been established, it is the duty of workers to formulate as exactly as possible how and when the transmission took place. This has been done by Elliot Smith, especially in the second communication under notice, the report of a lecture delivered in the John Rylands Library at Manchester.

The details of the process of mummification in Torres Straits agree with those of the XXIst dynasty in Egypt. From this and other indications Elliot Smith concludes that the migration which carried mummification and its associated customs to distant parts of the world set out on its journey about 800 B.C. He finds that the period following this date corresponds with one shown by several writers to have been a time of active development in India, China and other parts of the world. It would seem that some great impetus to the growth of culture took place more or less simultaneously in these regions; and Elliot Smith concludes that the fermentation was due to a leaven provided by the people who left the neighbourhood of Egypt with their megalithic culture eight centuries before Christ.

Not only does Elliot Smith thus assign a definite date to the first movement of the megalithic culture over the Earth; he ascribes the movement to a definite people, one already known to have played an active part in human history. After a period of relative neglect by historians, Elliot Smith ascribes to the Phœnicians a place in the history of mankind far more important even than that they were once supposed to hold. His thesis is that the Phœnicians received the art of building megalithic monuments and some of the associated elements of culture from Egypt, while other elements of the complex which belong to an earlier period of Egyptian history were adopted by the Phœnicians in the course of wanderings in the more immediate neighbourhood of their home. The complex culture so produced was then carried by this maritime people to the coasts of East and West Africa, to India, China, and Japan, to the islands of the Pacific Ocean and to the American continent.

It is not possible within the limits of this notice to deal critically with these far-reaching conclusions. One point only can be considered, and that briefly. The earliest movement of the culture is positively assigned to 800 B.C. In his Rylands lecture the author deals with one line of objection to this date, and shows that the inclusion within the megalithic

complex of elements belonging to an earlier period of Egyptian history can be satisfactorily explained by the survival of these customs to a much later date among surrounding peoples. There are however other lines of objection.

The scheme of Elliot Smith implies that the Phœnicians, who till 800 B.C. had limited their journeys to the Mediterranean, the Red Sea, Persian Gulf, and possibly India, were now led to extend them eastwards to China, Japan and America, as well as in other directions. The evidence which we possess concerning historical migrations shows that the great movements of mankind have usually been preceded by prolonged processes of slighter and occasional influence. If, as is supposed, there was a great movement of the Phœnicians in the seventh and eighth centuries B.C., it is probable that this movement only formed the acme of a long series of slighter movements in which especially daring and hardy mariners gained the experience and knowledge of geography which made possible the later movement on so large a scale. The problem must be decided by evidence, and not by such *a priori* considerations. But, as the matter stands at present, the evidence put forward by Elliot Smith does not seem sufficient to exclude such earlier movements as are suggested by our knowledge of historical migrations.

The work of Elliot Smith presents us with a scheme the details of which will only be filled in by the work of years. It provides us with a stimulating hypothesis, interesting not only for its own sake, but, as already pointed out, especially interesting in its relation to geography. If there have been the movements of culture tending to produce uniformity which are suggested by the work before us, we shall have to explain the great variety of human culture in different parts of the world. It will be our business to discover why one element of a complex failed to find a home here and another there; why after becoming settled in new homes one element of culture disappeared in one place and a different element elsewhere. Still more important, we have to seek for the causes which have produced modifications of the introduced elements of culture, modifications so great that it is often difficult to recognize the original nature of a custom. It is to the reaction of the human mind to the necessities of its environment, physical and social, that these modifications have been due. One of the most fascinating lines of work which lies before us is the determination of the part which has been taken by geographical factors in the production of these changes.

W. H. R. RIVERS.

GRAVITY DEFLECTIONS IN THE ANDES.

Colonel C. F. Close, C.M.G., R.E.

SIR THOMAS HOLDICH has recently given a valuable account of the operations of the Peruvian-Bolivian Boundary Commission. All those who have read this account will have realized what excellent work was done by the late Captain H. S. Toppin, whose death in action has deprived us of a very gallant officer and able explorer—a man who was not content with doing anything less than his best.

The joint Commission was faced with a difficulty not uncommonly found in mountainous regions, viz. the disturbance of the level by the attraction of mountain masses. In the neighbourhood of such a giant range as the Andes the disturbance is naturally very considerable, so much so that it becomes a matter of some importance to discover, if possible, its amount. Captain Toppin fully recognized the desirability of examining the question.

In a letter to the present writer, dated 4 May 1914, shortly before he went to France where he was killed, he said, "I am forwarding you all the data we possess respecting the deviation of the plumb-bob between Poto, our base in the Cordillera, and Marte, and shall be very grateful if you can evolve from this material a standard latitude for our maps. The stations 43 and 44 are included because, although not fixed by rigorous triangulation, there is probably not a discrepancy of more than three or four seconds (arc) between the interpolation results and the values that would have been obtained had all three angles been observed. . . . In the first region, unconnected with the triangulation, where we were doing a considerable amount of astronomical work, not only did the mean of a good series of observations . . . differ considerably from the mean of an equally good series on a subsequent night (the difference being sometimes as great as six seconds), but the results also seemed to be affected by the star's altitude. The forest stretched away indefinitely to the north, and 200 miles to the south lay the snows of the Andes. . . . The diagrams have been taken direct from our 1 : 250,000 maps, and if not sufficiently clear, I shall be bringing the originals down . . . shortly."

Then follow the details of the observations for latitude at Marte, Poto, Saqui (27), point 43, confluence Lanza-Tambopata, and point 44. These observations are really excellent, and show what a high degree of precision modern field instruments are capable of in the hands of skilled observers. The following is an abstract of the observations, showing the difference between the astronomical values and the trigonometrical (taking Poto as the standard latitude):—

LATITUDES IN THE CORDILLERA.

Station.	Name.	Astron. latitude.	Pairs.	Trig. latitude.	Trig.—Astr.	Height.
7	Poto ...	14° 40′ 35″·33	4	Accepted as initial lat.		15214
27	Saqui ...	14° 30′ 33″·7	1	14° 31′ 4″·24	+30″·5	14610
43	—	14° 18′ 32″·8	2	14° 18′ 49″·76	+17″·0	7662
44	—	14° 1′ 2″·0	1	14° 1′ 14″·58	+12″·6	4884
	Confluence Lanza—Tambopata	14° 0′ 48″·6	1	14° 1′ 3″·15	+14″·6	2640
60	Marte ...	13° 40′ 20″·13	11	13° 40′ 44″·1	+24″·0	1427

Stations 43 and 44 are not in the main triangulation, but are interpolated from the snow peaks. They should be accurate.

Previous values for the astronomical latitude of the confluence Lanza-Tambopata are—

Fawcett	...	...	14° 0′ 44″	Theodolite.
Mailles	...	...	14° 0′ 42″·5	Astrolabe.

Captain Toppin's Commission thus observed six excellent astronomical latitudes, one on the south side of the highest peaks of the Andes, and five on the northern slopes. Assuming, for the moment, that the astronomical latitude at Poto, the southernmost point, is errorless, the following are the differences (astronomical—geodetic) between the observed values and those derived by triangulation from Poto :—

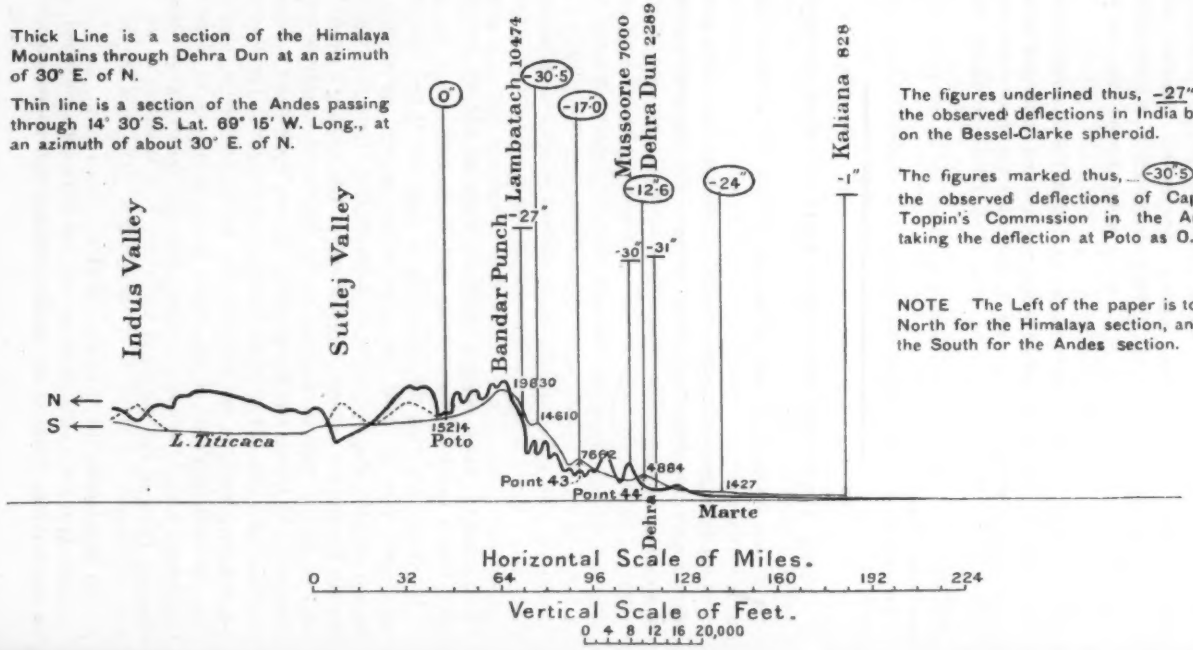
Saqui	...	...	−30″·5
Hill 43	...	...	−17″·0
Hill 44	...	...	−12″·6
Confluence	...	...	−14″·6
Marte	...	...	−24″·0

These negative values imply a deflection of the plumb-bob towards the south, that is, towards the snow range and pampa plateau.

We cannot say what the deflections at these points with reference to any chosen spheroid really are. Calculations of local topographical deflection are valueless, and we do not know to what extent the condition of isostatic equilibrium obtains in the Andes. But there is a general similarity of outline between this part of the Andes and the Himalayas near Mussoorie and Dehra, and by superimposing the two sections it is possible to obtain some idea of a plausible system of deflections. The accompanying diagram shows the two sections, the Indian deflections being taken from Professional Paper of the Survey of India, No. 13, by Major H. L. Crosthwait, R.E., "Isostasy in India," and the Indian section from Professional Paper of the Survey of India, No. 5, "Attraction of the Himalaya Mountains," by Major S. G. Burrard, R.E. The data for the Andes section were furnished by Captain Toppin.

Looking at these sections we should not have been surprised to find on the northern slopes of the Andes southerly deflections amounting to

CROSS SECTIONS OF THE ANDES AND HIMALAYAS.


Thick Line is a section of the Himalaya Mountains through Dehra Dun at an azimuth of 30° E. of N.
Thin line is a section of the Andes passing through 14° 30′ S. Lat. 69° 15′ W. Long., at an azimuth of about 30° E. of N.
The figures underlined thus, -27", are the observed deflections in India based on the Bessel-Clarke spheroid.
The figures marked thus, (-30·5) are the observed deflections of Captain Toppin's Commission in the Andes taking the deflection at Poto as 0.
NOTE The Left of the paper is to the North for the Himalaya section, and to the South for the Andes section.
Indus Valley
Sutlej Valley
Bandar Punch 10474
Lambatach
Mussoorie 7000
Dehra Dun 2289
Kaliana 828
0"
(-30·5)
(-17·0)
-27"
(-12·6)
-24"
-1"
-30"
-31"
N
S
L. Titicaca
15214
Poto
19630
14610
7662
4884
1427
Point 43
Point 44
Dehra
Marte
Horizontal Scale of Miles.
0 32 64 96 128 160 192 224
Vertical Scale of Feet.
0 4 8 12 16 20,000

30 seconds or so. As a fact, we find, if we assume the astronomical latitude of Poto as errorless, a series of southerly deflections averaging about 20 seconds. It is, of course, probable that the Poto latitude is not errorless, and it may very well be affected itself with a southerly deflection. But, all things considered, it is less likely to be affected than the latitudes of stations on the northern slopes.

The advice given, therefore, was to accept the observed latitude of Poto and to reject the observed latitudes of stations on the northern slopes. There was, alas! no opportunity of discussing the matter fully with the Head of the Mission. But the writer knows that he agreed with this conclusion.

2 April 1916.

SIR ERNEST SHACKLETON'S EXPEDITION.

AT the Meeting of the Society on May 8 the President spoke as follows:—

"Before we proceed to the business of the evening I think you would like to know the position in which things stand with regard to the Antarctic and to the prospects of something being done to find out what has happened to Sir Ernest Shackleton's expedition. As you know, no news has come through in the last fortnight from the Weddell Sea, and the time is now drawing to a close, or has almost drawn to a close, in which we can reasonably anticipate any news of the release of the ship which took him out there. There is too much reason to fear it has either met with some misadventure—not necessarily of a fatal nature—or that it is drifting in the ice and has been unable to reach the open sea and return to civilization. That being the state of the case, it is obvious that the question of search and relief has become an urgent question. I have been in communication with the Prime Minister on the subject, and we are still in communication, and to-day I have received official intimation that a small expert Committee is being formed under Government control by the Admiralty, and that we shall receive shortly an invitation to appoint a delegate to represent the Geographical Society upon that Committee, the business of which will be to decide what steps shall be taken to discover what has happened in the Weddell Sea to the ship, which may very possibly have its whole original complement on board, since it is uncertain whether Shackleton would be able to accomplish his very bold undertaking of crossing the Antarctic continent."

In response to the invitation of H.M. Government the Council appointed Major Leonard Darwin, R.E., Past President, to represent the Society on the Committee, which includes the Hydrographer to the

Admiralty, Sir Douglas Mawson, and Dr. Bruce, with representatives of Government Departments and of Sir Ernest Shackleton, under the chairmanship of Admiral Sir Lewis Beaumont, a member of our Council.

A Reuter's message from Melbourne published in London on May 16 announces that in response to an inquiry from the Colonial Secretary the Minister of Defence has expressed the readiness of the Commonwealth "to assist in organizing an expedition which should consist of five officers and twenty men and provisions for eighteen months." This evidently relates to the relief of the *Aurora's* party left stranded at Ross Island. Mr. Stenhouse, chief officer of the *Aurora*, is on his way to England. No news of the *Endurance* had been received up to the time of going to press.

REVIEWS.

EUROPE.

Sweden: Historical and Statistical Handbook.— Edited by **J. Guinchard.** Stockholm: Government Printing Office. 1914. 2 vols. Pp. xxvi., 781; xi., 759. *Maps and Illustrations.*

THE second edition of this excellent official handbook makes its appearance in two volumes, which together are nearly half as large again, in number of pages, as the first single-volume edition. The rapid economic development of the country is the principal cause of this growth; it has necessitated not only an increase in the total number of articles and the expansion of many of the original chapters, but also a large addition to the number of illustrations. Revision and addition appear to have been carried out with great thoroughness, and a tribute is due to the general editorship, which shows evidence of scrupulous care in the heavy task of harmonizing and preserving the proper perspective through the contributions of a large number of expert writers. These volumes set an example which other countries might well follow. There is still some little room for criticism of the rendering of technical expressions in English.

O. J. R. H.

ASIA.

Russian Expansion on the Pacific, 1641–1850.— **F. A. Golder.** Cleveland, Ohio: A. H. Clark. 1914. Pp. 368. *Facsimile Maps.* 21s.

The author of this book is an American who, having served the United States Government in Alaska, meant to write the story of that country as a part of American history, but found himself constrained to regard it, instead, as the closing chapter of a period of Russian expansion. The result, so far, is the present monograph on the conditions and history of Russian expansion on the Pacific up to A.D. 1750, with a promise of completion to date at some future time. We may say at once that Mr. Golder's book makes contributions of no little value to our knowledge of the subject in hand, thanks chiefly to the fact that he has had recourse to first sources and even to original documents; and there are very few books in English upon Russian subjects of which the same can be said. But when history is dealt with in this way it must always be a matter of extreme difficulty to condense the material satisfactorily within the

limits of one moderate volume, even when the framework—subject, period, and extent of country under examination—is less comprehensive than in the present instance. Mr. Golder would probably be ready to admit that his earlier chapters—just one-half of the book—which take us up to Bering's first expedition, are far from exhaustive. We should be glad to think, too, that his terrible picture of Russian depravity and cruelty in Eastern Siberia is overdrawn. Unrelieved by a single point of light, it is composed almost entirely of statements for which chapter and verse are quoted in contemporary Russian documents. But there must be something on the other side; nay, there certainly is. For instance, we are not told that it was strictly forbidden to make slaves of those natives—the great majority—who submitted and paid "Yasak," *i.e.* the tribute in fur. Yet there is positive evidence of successful appeals against the infraction of this law. Chapter II. "Russia and China on the Amur" gives us once more the fairly well-known story—a pitiful one at best—of Russia's temporary conquest of the Amur in the seventeenth century. What is disappointing is to find that Mr. Golder, like all his predecessors, seems totally oblivious to the cardinal fact that the arrival of the Russians on the Amur (A.D. 1644) coincided with the Manchu entry into Peking; that the "Chinese" he speaks of as failing to act energetically against the Russians at the time of their first aggressions were the Manchus, who were engaged in no less a task than that of conquering China, while holding the Mongols in hand by a policy of mingled bullying and conciliation. He says, strangely enough, "The saddest reflection of all is that, after these fifty years of conflict (this would bring us to 1694) with Russia on the Amur, the lesson was completely lost on China." Yet in spite of the gigantic task accomplished elsewhere by Kang-hi—and as late as 1675 he was faced by a hostile combination that threatened his brand-new empire with destruction—he had succeeded by 1689 in totally excluding the Russians from the Amur, where they reappeared only at the time of the Crimean War, and then made good their footing thanks solely to the French and English attacks upon China.

With Mr. Golder's carefully argued conclusion against Dezhneff's claim to have reached the Anadir by sea, through what we now call Bering's Strait, we are fully in agreement. The evidence in Dezhneff's favour is weak, contradictory, unconvincing; the considerations against him most weighty. Yet we would point out that *peredni konets za Anadir reku* is not adequately translated by "the forward end of the Anadir;" it distinctly means "beyond the Anadir," and were it not for other considerations the fault would be a grave one. A brief account of the discovery of Kamchatka and the Kuril Islands, with the forcible seizure of the former, and a summary of the *Terra de Ieso* question that once loomed so large, bring us to Bering and the twenty-five years' exploration connected with his name. Of all this our author gives us a clear and sufficiently full account, into which, however, we have not space to enter. It is a story of some heroism, much suffering, resulting in a substantial addition to scientific knowledge, and of many failures, the most remarkable, as Mr. Golder points out, being that the Bering expeditions left the main problem—whether Asia and America were joined or not—unsolved; though the presumption long held, even by Martini the Jesuit a century earlier, that they were separated by a narrow strait, united henceforth nearly all suffrages.

Bering was not a great navigator; even less was he a great leader of men. His accomplishment fell far short of what might have been expected from a La Pérouse, a Cook, a Nordenskjöld, or almost any one of the great band of modern Arctic explorers.

Not only did he not solve the main problems of his two expeditions; on the first occasion, he never set eyes on America; on the second, he did just that and nothing more, neither landing himself nor making any attempt at exploration. A map of the St. Petersburg Academy, dated 1773, "still puts 20 degrees as the narrowest place in Bering's Strait;" on the other hand, some still held that the two continents were joined further north. There was no proof to the contrary.

However, Bering did his best: he died a miserable death, reaping no reward for himself, and it would be churlish to grudge him his fame.

Some minor defects in this volume may be pointed out with a view to their correction in a future edition. The Russian prepositions "k" and "v" in the middle of a sentence should not be written with capital letters, and we should like once more to enter a protest against such forms as Czar for Tsar, Woewod for Voevoda, Jakutsk for Yakutsk, and the use of "ch" for the Russian "x." *Tscerteznaya*, too, is a poor rendering of *Chertezhnaya*. These are the German or Polish forms, and are ugly and misleading in English. Otherwise Mr. Golder's transliterations are refreshingly, indeed quite unusually, sensible. *Deti-boyarski*, we may remark, had no hereditary value, in spite of its literal meaning, nor did *sluzhili* mean "servant" in seventeenth-century Siberia. We should like to follow Mr. Golder and nearly all who have gone before him in his high estimate of Witsen's maps. Poor Witsen! he devoted all his spare time during many busy years to the geography of Northern Asia, and he has left us a priceless collection of material—in a most chaotic state; but his efforts to put all this on to a map ended lamentably, as any one will see who compares his earliest effort, the map of 1687, with the versions he revised for his edition of Izbrandt Ides' Journey (1704) and for Allard's Atlas (?1708–10), which latter may, perhaps, be taken as expressing his final views. The bifurcation of the Amur in the map of 1687 would be hard to beat as a geographical error. Witsen, we are told, visited Russia in the time of Peter the Great This is an old mistake. He was there but once, and that was in 1665. Ortelius has only one "1"; Vander Aa needs only one capital A. Mr. Golder tells us that Eastern Siberia is bounded on the west by the Lena. This is not the Russian view. In a note on page 263, the date 1715 is printed for 1849. We are told that the Tsar "requested" his officials to draw up maps of Siberia. In such cases Tsars do not request. "Several sheets of his (Remezoff's) maps were completed as early as 1673." We should say that the earliest sheet in the Remezoff Atlas—the last—is of 1674, and that *that is not Remezoff's!* We are told that there is little to indicate that Sakhalin was generally known in China. "Generally" is a vague term, but the Mings sent expeditions to the mouth of the Amur, and one can hardly suppose that the Manchus knew nothing of it.

We make these comments in no carping spirit; and we shall look forward with interest to the continuation of the present work.

J. F. B.

The Caliph's Last Heritage: a Short History of the Turkish Empire.— Sir Mark Sykes. London: Macmillan. 1915. *Maps and Illustrations.* 20*s. net.*

SIR MARK SYKES' account of his travels in Turkey appears at an opportune moment, the Sultan's Asiatic dominions, and the variety of the peoples inhabiting them, being not too well known to Englishmen. He has endeavoured before to enlighten his countrymen on these subjects, and this book, coming as a sequel to his 'Dar-ul-Islam,' well deserves their attention and thanks. The present importance of the work is somewhat hidden by its title. This, strictly

speaking, applies only to its first part, which is quite independent of the travels. It is a brilliant sketch of the origin and rise of Islam as a political power in south-west Asia, culminating in the Ottoman Empire. Sir Mark unfortunately gives no authorities for his historical statements, which are illustrated by many acute reflections and striking characterizations.

The second half of the book contains the diaries of the author's travels during the years 1906–1913. As in his previous works, he publishes the diaries just as they were originally written. In consequence they no doubt gain in vividness and force, but may suffer from want of reconsideration in the calmer atmosphere of the study.

The first journey, by far the most extensive, was made in 1906. It led east from Aleppo over the Euphrates and across the Jazireh to Mosul, whence, after an excursion into Irak, Sir Mark struck north-west to Diarbekir, and crossed the midlands of Asia Minor to Sinope—an excellent port, but rendered comparatively useless by the poor communication with the interior due to Turkish maladministration. From Istifan a romantic climb over mountainous country brought him to Kastamuni, perhaps the most beautiful city in all northern Asia Minor, whence he again went east by a more northerly route, ultimately reaching Erzerum. Just now his description of Erzerum and its neighbourhood cannot fail to attract attention. It is a good example of his emphatic and incisive style. The surrounding country is bare and desolate, the town itself meaner than a village, with nothing so cheerful as the graveyards. "It is surrounded by fortifications, but what madman would attack it? Did not the crazed Timur pass by, appalled by the ugliness of the place?" He found that on the way from Kara Hilsa to Erzerum the squalor of the villages and the vileness of the buildings increased as the Turkish influence decreased. The evil effects of Europeanizing Orientals is a favourite theme of the author's, and he states his views on the subject with much force and even feeling. Finally Mosul was once again reached by way of Mush, Bitlis, and Van.

Colonel Sykes describes this journey with a freshness, a vigour, and even a dogmatism which are quite stimulating. He revels in the natural beauties of the country, and his observations on the peoples he met are full of interest and acuteness. The accounts of his meetings and interviews with local chiefs and officials are most entertaining, and their characters and foibles could hardly be hit off better than in his few striking sentences. Especially important are his studies of the Bedawin, Kurds, and Armenians, and under present circumstances his remarks on the last-named people compel attention. His estimate of the town Armenians is distinctly unfavourable. "That the Armenians are doomed to be for ever unhappy as a nation seems to me," he says, "unavoidable, for one-half of their miseries arise not from the despotism under which they live, but from their own dealings with each other." His opinions are equally clear regarding the other peoples mentioned. "The Bedawi is, indeed, the strangest of all mankind. His material civilization is about on a par with that of a Bushman, yet his brain is as elaborately and subtly developed as that of any Englishman with a liberal education. There is no reasonable argument he cannot follow, no situation he cannot immediately grasp. . . . Yet there is no manual act he can perform. How different from the Kurd, whose hands are ever ready and busy, but whose mind has many closed doors and blocked-up passages! A Kurd is the simplest and most gullible of mortals. His fear of a man who can read the Koran is piteous, his wickedness is the wickedness of a wild animal, his inquisitiveness great, his industry immense. The two races seem undoubtedly destined for amalgamation, and

if this ever takes place on a large scale the world will be the richer by a magnificent people." The close study he has made of the Kurds is shown by the valuable appendix in which their tribes are classified and their characteristics and distribution explained.

The journey of 1909 is entitled 'Huriyeh,' and its chief interest lies in the observations of the effects produced on the inhabitants by the declaration of the new constitution. Beginning with a visit to Petra, it eventually brought Sir Mark Sykes across the hilly and forested country between Kirkagach in North-West Asia Minor and Brusa, perhaps the most charming city within the Ottoman dominion, where there is still something of the old Turkish spirit left. The attitude of the people in town and country towards the new *régime* is vividly described. The author formed the most pessimistic opinions regarding the benefits likely to result therefrom—opinions which subsequent events have thoroughly justified.

In 1913 Sir Mark started from Constantinople, where after five years the new constitution was an utter failure. At Brusa he found a rather better state of affairs. At Konia he visited the zikr of the Mevlevi dervishes, and gives a graphic account of what he saw, their fine mosque, and the singular ceremonies of their devotions in its dancing-hall. These certainly suggest that there is much more method in the madness of the dervish than is generally supposed. Sir Mark's preference for the simple, sturdy village Turk above his fellow of the town is expressed in the remark that when in Turkey he leaves the villages and comes to the hotels, he feels like one who comes from civilization to savagery. The picturesquely situated town of Ermenek, which he came upon after struggling through a wild and stony country, is described as rich and happy, but only because it was away from the railway and thus out of reach of contaminating European influences. He reached the sea-coast at the great ruined fortress of Kiz Kala, and a ride through long stretches of ruined cities, crumbling towns, and broken aqueducts brought him to Mersina, the terminus of a quite useless branch of the Bagdad railway. This gives him the opening for an expression of opinion, in characteristic style, regarding German ways and methods, and German incompetence in developing a new country. The value of the book is enhanced by a very full index.

E. A. P.

AFRICA.

A Naturalist in Madagascar.— **James Sibree.** London: Seeley, Service & Co. 1915. 52 *Illustrations and* 3 *Maps.* 16*s. net.*

Mr. Sibree's 'Naturalist in Madagascar' is an interesting and instructive book. It presents, in a very readable form, a large amount of information concerning the vegetable and animal life of the great island in which the author has passed a lifetime. If it is not an exact treatise on Malagasy zoology and botany, neither is its scope confined to those subjects. There is as much in it about the Malagasy races as there is concerning flora and fauna; indeed, the account of the people, their industries, their mode of life, their mentality, is as attractive as anything in the book.

The author's method is to narrate various journeys through the island, beginning with his first coming to Madagascar in 1863, and to make his travels the thread on which his notes on the people and natural history are strung. There is also a more detailed account of the central province of Imèrina, shown in all its changing seasons. Mr. Sibree succeeds very well in what, from the geographer's standpoint, is an essential task—he presents a clearly recognizable picture of what the country looks like. As an introduction to a study of

Madagascar his work deserves cordial commendation. It has, too, something of the charm of an old-world book of travel, for in dealing with the people Mr. Sibree wisely depicts them as he knew them for thirty years previous to the French conquest of the island. Of the changes which have occurred since we get but hints (one of these hints, almost a sigh, shows us the French as great road makers). This picture of Malagasy life in the days of Hova supremacy has permanent value. So also have the author's notes on burial customs, some obviously derived from remote sources and of great antiquity. Again the descriptions of the hill villages, surrounded by a series of deep fosses, arrest attention. We hope that the author will give us another book dealing specifically and more fully with the early history of Madagascar and the extent of Arab, Indian, and African influence on the people.

The student may be tantalized by the disjointed manner in which Mr. Sibree presents his information, especially as the index is not as informative as it might be. The average reader is more likely to be content with the stimulating *olla podrida* set before him. The illustrations are excellent, and the maps sufficient for their purpose.

F. R. C.

AMERICA.

The Rubber Industry of the Amazon.— **J. F. Woodroffe** and **Harold Hamel Smith.** London: John Bale, Sons and Danielsson. 1915. Pp. xlviii., 435. *Illustrations.* 21*s.* net.

A previous book by Mr. Woodroffe, 'The Upper Reaches of the Amazon,' recording his personal experiences in that region, was noticed in the *Journal* last year (vol. 45, p. 244). When war broke out he had arranged to collaborate with Mr. H. Hamel Smith, the editor of *Tropical Life*, in the production of the present work, which discusses the conditions under which the rubber industry in Brazil is conducted and advocates measures for its further development. Mr. Woodroffe has enlisted, but he placed his notes at Mr. Smith's disposal, and though there are doubtful points which cannot be cleared up in his absence, Mr. Smith has assumed the responsibility of bringing out the book, grafting his own information and conclusions on to the material left in his hands. It is, indeed, his vigorous spirit which dominates the work. The style is diffuse, some of the ideas are rather wild, and generally the book exhibits the defects of a conglomeration of imperfect data. Mr. Smith cheerfully admits all its faults, but argues that it is better to let the book come out and pass through the fires of criticism than to delay publication indefinitely. He believes that he has valuable suggestions to offer on the subject of immigration into Brazil and the relation of the rubber industry to agricultural development generally. As an incentive to discussion the book should serve a useful purpose.

The Real Argentine.— **J. A. Hammerton.** New York: Dodd, Mead & Co. 1915. Pp. 453. *Illustrations.* 2 *dollars* 50 *cents.*

The many books which have been published about the Argentine Republic in recent years have been more appreciative than critical. In Mr. Hammerton's account of "the real Argentine" criticism outweighs appreciation. The book is less comprehensive than the title would imply, for the bulk of it is concerned with Buenos Aires. Other towns and life in the "Camp" are dealt with rather cursorily. Buenos Aires, however, reflects many of the essential characteristics of Argentine progress. Mr. Hammerton deals with the city very faithfully, and though some may think that his criticisms are marked by a spirit of undue acerbity the book is a useful corrective of extravagant eulogies. Some

impressions of Uruguay, based on a summer's residence in Montevideo, are also included in the book.

Cuba. Old and New.— A. J. Robinson. London: Longmans, Green & Co. 1916. Pp. xiv., 236. *Illustrations.* 7*s.* 6*d.* net.

Several chapters deal with Columbus and the discovery of Cuba, the relations of Cuba with the United States, and its revolutions and independence. Chapter XI. gives an interesting account of the "filibusters" who resembled the "blockade runners" of the Civil War. There is a good general description of the country, though, unfortunately, no map has been included.

A useful chapter gives a detailed account of the sugar industry and there is in addition a summary of various products and industries which has been brought carefully up to date.

GENERAL.

The Life of Lord Strathcona and Mount Royal.— Beckles Willson. London: Cassell & Co. 1915. Pp. xvii., 632. *Illustrations.* 25*s.* net.

In this volume Mr. Beckles Willson has raised a noble monument to the late Lord Strathcona. It is not a critical biography, but is valuable for the very full information it contains, not only about Lord Strathcona's later years, when he was associated with the building of the Canadian Pacific Railway and other events with which his name will be handed down to history, but about his early days in the service of the Hudson's Bay Company. Lord Strathcona was so long and so widely known to fame that some even of his contemporaries are apt to forget how large a proportion of his life was passed in the employment of that great corporation. He was, in fact, nearly fifty years of age before he began to figure prominently in the public eye, and his subsequent career extended over nearly as long a period. Mr. Willson has had access to hitherto unpublished material, and is able to throw new light on several aspects of a career which must always be of interest to Canadians and to all students of the growth of modern Canada. That Lord Strathcona was not wholly immersed in business concerns, even when as plain Donald Smith he was working in Labrador for the Hudson's Bay Company, is shown by what Sir Leopold McClintock wrote of him in 1860. When Sir Leopold visited North-West River, Labrador, during the survey expedition which he carried out for the North Telegraph Route, he called on the Chief Factor, and has left it on record that in the evening after dinner Mr. Smith gave the party a most enjoyable description of the country, "showing a most intimate knowledge of the geology, its fauna and flora, and the native population. For a man situated off the beaten track, as he is, he displayed a surprising familiarity with current events."

Surveying and Field Work: A Practical Text-book on Surveying, Levelling, and Setting-out. London: Constable & Co., Ltd. 1915. 7*s.* 6*d.* net.

The survey methods described in this book are those of the Cadastral Survey, and suitable for the compilation of large-scale plans of comparatively small areas. Astronomical determination of position and plane-tabling are expressly excluded by the author, and the book is therefore of little use to those engaged in geographical or exploratory work. For detailed site-plans and similar work the methods dealt with, which are fully and clearly described, would however be useful.

N. F. M.

THE MONTHLY RECORD.

EUROPE.

Hydrology of the Po.

A VALUABLE series of data yielded by the daily observations at the gauge at mouth of the Ticino ("idrometro della Becca") from 1851 to 1912 has been issued by the *Ufficio idrografico del Po* at Parma (1915). The publication follows on that issued in 1908 by Commander Pelleri, which recorded the daily observations at the Pontelagoscura gauge near Ferrara from 1807 to 1907, and it is hoped in time to publish volumes for all the gauging stations, and so to supply an adequate basis for the study of the *régime* of the river. The present work does not profess to do more than afford an instalment of the raw material for such a study. In a series of tables and diagrams it shows the stage of the river at noon for each day throughout the period dealt with; the maxima, means, and minima for each 10-day period and for each year; the number of days in each year on which the level has stood at each successive stage between the minimum and maximum, and so on. The series ends with a general view of the course of each flood during the period in question (a flood being reckoned as a stage in which the level reaches 5 metres and more above zero of the gauge), its time of beginning, culmination, and ending being recorded as well as the maximum level attained. Incidentally a point of geographical interest is touched upon in the notes on the changes to which the courses of the Po and Ticino have been subject since 1821, the records permitting the state of things to be shown on a chart for each of the dates 1821, 1852, 1874, and 1906. This brings out the fact that whereas the confluence shifted some 600 metres to the *north* between 1821 and 1852, between 1858 and 1874 it moved about 1500 metres to the *south-east*, this change having apparently been brought about chiefly by exceptional conditions in 1868 and 1872. Soon after this the Ticino itself changed its course by cutting off a northerly loop above the confluence. These changes must be taken into account in any comparative study of the records of different periods, as they have no doubt affected the readings. In fact the gauge is now really on the Ticino and not on the Po, though near enough to the junction to feel the effects of changes in the level of the latter. The observations seem to show a certain rise in the low-water stage within recent years, though the contrary movement is to be noted at the Pontelagoscuro gauge.

AFRICA.

Antiquities of the Middle Niger.

It is known that during recent years French travellers—Desplagnes and others—have done much to bring to light remains of antiquity in the Middle Niger region, remains which will greatly help to elucidate the still obscure early history of this part of North Africa. Down to the outbreak of war such researches were being actively prosecuted, and some of the most recent results are described in the *Bulletin* of the geographical section of the Comité des Travaux Historiques et Scientifiques (Tome 29, Année 1914: Paris, 1915). M. de Gironcourt, who in a first expedition had secured drawings of inscribed stones which aroused considerable interest in Paris, returned to the country in 1912 charged by the Académie des Inscriptions with the task of making as complete a collection as possible of such inscriptions, and this was carried out with the greatest success. Whilst a certain number of actual specimens of inscribed stones were collected, the work lay chiefly in the direction of obtaining

impressions ("squeezes") of the inscriptions, so as to avoid offence to the natives, who regard the stones with veneration, and on whose aid the traveller chiefly depended for discovering the sites and securing the results aimed at. He examined a large number of sites, chiefly of ancient burial-places, and kept a careful record of their exact location and of the position of each inscription obtained. None was considered too slight or fragmentary to be dealt with, and the result is a very complete *corpus* of inscriptions numbering over eight hundred. The sites fall under three main divisions: (1) Those of the valley of the Niger above Gao; (2) those of Adrar of the Iforas, the most interesting here being in the vicinity of the old town of Es-Suk; (3) those of Gao and its neighbourhood. Each of these three series is distinguished by special characteristics. From a geographical point of view the study of the remains may be expected to throw light on climatic and other changes to which the region has been subject in comparatively recent times. Thus a series of impressions obtained at Dia (a very ancient town of Massina) form a veritable atlas of natural history, giving as they do a very complete representation of the fauna of the region at a time when thick-stemmed trees still grew on the Niger banks in parts which are now almost bare. The animals represented range from the monkey to the elephant, and the various types of gazelles and antelopes can be clearly distinguished. Other researches described in the same *Bulletin* are those of M. Bonnel de Mézières, who in 1913 examined the site of an important Jewish settlement near the old town of Tendirma, in the lake region north of the Middle Niger. He succeeded in finding traces of the wells made by the settlers for the irrigation of their fields as described in the Tarikh *El Fetash*, lately translated by MM. Houdas and Delafosse. The settlement bore the name of Fati still applied to the neighbouring lake. M. de Mézières also succeeded in finding the site of the ancient town of Tirekka, formerly of great importance as described by Bekri. It lies a little north of the Niger, some 25 miles east of Timbuktu.

The French Occupation of Tibesti.

From an announcement in *L'Afrique Française* (1916, 1 and 2) it appears that the region of Tibesti recently occupied by the French (see the *Journal*, vol. 46, p. 343) has been attached, administratively, to French West Africa. A new "circle," that of Kauar-Tibesti, replaces the former circle of Bilma. It is divided into two sectors. That of Kauar includes the oases of Kauar, Agram, Jado and the district of Yat-Ichuma, and has its headquarters at Bilma; that of Tibesti, which includes both sides of the Tibesti massif, has Bardaï for headquarters. An administrative post has already been created at Bardaï, and two military posts have been established—one at Bardaï, the other at Zauar (called Fort Gouaillard). The sedentary population of Tibesti is stated, in a military report, to consist of some four thousand Tibbu.

AMERICA.

Distribution of Snowfall in the United States.

Besides the articles on rainfall referred to in our last number, the 1915 volume of the *Monthly Weather Review* contains others dealing with the snowfall. There is a paper by C. F. Brooks on the snowfall of the eastern United States, and another by A. H. Palmer on the region of greatest snowfall in the States. On account of low temperature and dampness the Lake region, Appalachians, and north Atlantic coast get much more snow than the warmer regions of the Ohio, south Atlantic and Gulf States. The north-east wind

being both cold and damp over the whole eastern States, brings heavier snowstorms than the cold but dry north-west wind except on windward slopes and in lee of the Great Lakes. The region of heaviest known snowfall in the United States is declared by Mr. Palmer to be the high Sierra Nevada in California, where more than 100 inches of unmelted snow falls every winter. For individual stations the average annual snowfall is often enormous, the highest figures being 419·6 inches at Summit, Placer County, on the basis of a 44 years' record, and 521·3 for Tamarack, Alpine County, on an 8 years' record. Mr. Palmer produces some splendid photographs of snow scenes, and also discusses the important economic effects of such huge snowfalls, especially in relation to the working of the railroads and the construction and cost of snow-sheds. The Sierra Nevada are for the most part free from snow during the later summer and early autumn months, July to end of September. During recent years several papers have appeared on the subject of snowfall in the United States, showing that the Americans with their characteristic meteorological proficiency realize that snow, not only in its appearance but in many of its effects and economic functions, is a very different thing from rain, and requires to be studied separately as well as in association with the latter. No scientific data at all exist for the snowfall of Great Britain and Ireland, and it is high time that a study of the subject were initiated in a country where the total depth of intermittent snowfall occurring during the winter and spring months is, at all events in Scotland and many parts of England, often decidedly great, even in the lowlands.

AUSTRALASIA AND PACIFIC ISLANDS.

Irrigation in Australia.

It is announced from the office of the High Commissioner for the Australian Commonwealth that substantial progress is being made with the Water Commissioner's scheme to provide irrigation facilities for an area of some 8000 square miles of hitherto arid country in the Wimmera district of Western Victoria. The water is obtained by storage of the high-water supply of the Wimmera River, which will thus be made available at low-water periods. Several of the main channels have already been completed and are supplying parts of the Borung and Karkarooc counties, a further extension of the system being shortly expected. The main reservoir at present is Lake Lonsdale, but a subsidiary supply will be made available by the new regulator of the Avon (the next important stream east of the Wimmera), as also by storages on Black Swamp and Taylor's Lake.

The White Man in Tropical Australia.

We have received from Mr. A. W. Pearse the reprint of an article by him in the *Pastoral Review* for 16 February 1916 dealing with the question of white *versus* indentured labour in Northern Australia. The writer holds strong views as to the impossibility of the development of Tropical Australia by white labour alone, and supports his views by reference to the wet-bulb temperature records for that part of the Commonwealth. He justly points out the importance of a study of the wet-bulb rather than the dry-bulb readings, as the latter give no indication of the humidity, which is of course the main obstacle to severe and continued labour by white men in the tropics. A wet-bulb temperature of 80° has been recorded as the 3 p.m. mean for January at Darwin, while the average is given as 78°. Such conditions are far more trying to Europeans than temperatures of 100° (dry-bulb) with a low relative humidity.

Taking an average wet-bulb daily maximum of 75° (one that has never been recorded at Melbourne) as the limit above which continued white labour is impossible, Mr. Pearse shows the course of this isotherm on a sketch-map, and holds that north of this line native labour under white supervision is a necessity. The line cuts off all the coast regions of Australia north of the tropic, though curving inland so as to leave as "White Man's Land" a considerable part of the interior north of the same. Such a line is held to be preferable as a line of division to a purely arbitrary one such as the tropic itself.

MATHEMATICAL AND PHYSICAL GEOGRAPHY.

Climatic Variations in Historic Time.

This oft-discussed question has lately been reconsidered by the well-known Swedish oceanographer Prof. Otto Pettersson, who, approaching the subject from the standpoint of cosmical physics, attempts to demonstrate a synchronism between the moon's periods and variations in the Earth's climatic elements ('On climatic variations in historic and prehistoric time.' Svenska Hydrog.-Biolog. Komm. Skrifter, Häft V.). At the outset it should be noted that the evidence adduced in support of the theory is certainly scanty, and it is to be regretted that when the author draws conclusions which can hardly strike the student otherwise than as anomalous, he does not offer a word of comment or explanation. But even if the value of the investigation be put for these reasons at a minimum, it is nevertheless interesting as opening up new fields of inquiry, and neither the oceanographer, the meteorologist, nor the astronomer will wish to ignore the issues raised. It is held that the combined tide-raising force of the moon and sun upon the Earth is at a maximum once in about eighteen centuries (with various minor periods), the last absolute maximum occurring about the end of the Middle Ages, and the one before that in the third or fourth century B.C. Evidence is produced to show that at both these epochs violent storm-floods and catastrophic inundations occurred on the Atlantic coasts, and that there were climatic alterations in different parts of the world; both sets of phenomena being attributed to the increased tidal energy of oceans. Now the phrase "absolute maximum" is impressive; but it has in reality no more than arithmetical importance unless it be shown that the sum-total of tidal effects about these epochs is also a maximum, which the author does not attempt to do. It is not merely to the surface phenomena of bigger flood-waves and greater difference between spring and neap tides that the effects are attributed, but an important part is held to be due to submarine tidal waves resulting from the impingement of the oceanic tidal wave on submarine ridges. Such submarine waves would persist at the boundary between light surface water and salt deep water—a stratification common in the Arctic seas and elsewhere. It is pointed out that in the thirteenth, fourteenth, and fifteenth centuries the Baltic in certain winters was completely frozen over, and the cause is held to be oceanographic rather than meteorological. The stronger influx of Atlantic water would thin out the light surface layer in the Baltic and cause it to freeze more readily, whilst in summer the same thinning of the surface layer would involve its more rapid heating. Such effects would, Prof. Pettersson maintains, react upon the Scandinavian countries, making the climate more continental. He discusses the case of Greenland and Iceland at special length, as his views are quite at variance with those of Dr. Nansen on the subject, as also in relation to the "Wineland" controversy. Historical evidence is adduced testifying to the prevalence in the Viking Age of comparatively mild conditions both in Greenland and Iceland. As regards Greenland, they

are attributed to a greater intensity of the Irminger branch of the Gulf Stream causing the Arctic ice to melt in higher latitudes, these conditions being altered when the tide-generating force waxed to a maximum. All this is interesting enough. But the innocent geographer must not accept the semi-paradoxical astronomy as in its nature mathematical and therefore true, if unintelligible.

GENERAL.

Memorial to Captain Scott in St. Paul's.

The memorial to the Antarctic heroes which it was some time ago decided to erect in St. Paul's Cathedral was unveiled on May 5 by the Prime Minister, who made feeling reference to the heroism displayed by Captain Scott and his companions in the tragic circumstances of their retreat from the South Pole. The memorial—a tablet in bronze—is placed near the entrance to the crypt, and contains a medallion portrait of Captain Scott, with a panel showing in relief the explorers on the march over the South Polar wilderness. The whole is surmounted by three allegorical figures holding five wreaths, and representing "Discipline," "Courage," and "Glory." A special form of service was used at the ceremony, the congregation including—besides the Prime Minister—the Lord Mayor and Sheriffs, Sir Wm. Crookes (past President of the Royal Society), Mr. D. W. Freshfield (President of the Royal Geographical Society), Admiral Sir Lewis Beaumont, Lord Beresford, and others.

The Turks.

In view of the intervention of Turkey in the present war Dr. Eugen Oberhummer has undertaken in the *Geographische Zeitschrift* for 1916 an opportune study of the Turks and their Empire. The first part, contained in the February number, deals with the question of the ethnic relations of the Turks in their several branches, the thorny problems of race and language as ethnographic factors being judiciously handled. The first part deals with the general distribution and subdivision of the Turks in the widest sense of the term, as denoting one of the main subdivisions of the peoples whose fundamental linguistic relationship, from Hungary and Lapland to Japan, has caused them to be grouped together under the general designation of Ural-Altaic. With its present centre of gravity in Turkestan and an original home in the Altai, the Turkish group of these peoples occupies an unbroken habitat stretching from the Caspian to Lob Nor, and from the border of the Iranian highlands to the latitude of Tobolsk, with an outlier in the far north represented by the Yakuts on both sides the Arctic circle. While the last-named have moved north-east from the original home of the race, other branches of the Turks have taken a south-westerly direction, crossing the Volga into European Russia and the Iranian domain into Asia Minor and the Balkan Peninsula. Their most westerly settlement within historic times was that of the Kumans, who in Hungary retained their speech, nomadic life, and paganism down to the fourteenth century and later. Dr. Oberhummer takes the fifteen main branches of the Turks in turn, sketching their fortunes in the past and their present distribution and approximate numbers. The importance of the Turkish (Tatar) element of the population of the Russian Empire is shown by the fact that in 1897 it formed over 10 per cent. of the total, and even in European Russia (without Caucasia) exceeded 4½ millions. In the Empire as a whole it now probably exceeds fifteen millions. The total number of the Ottoman Turks is estimated at about ten millions—eight in Asia Minor, two in the Balkan Peninsula—though it is a matter of difficulty to arrive at trustworthy figures for the latter, where so many of the original inhabitants have adopted the speech

and creed of the Turks. The grand total of all the Turkish groups is placed at about thirty millions. As regards the racial question, Dr. Oberhummer points out that unity of speech and race are retained only so long as a homogeneous group of people dwells together in a well-defined area, and that this has not been the case with the Turks. While maintaining their language, they have in their wanderings so mixed with the peoples subjected to their domination that the original Mongolian type has almost entirely disappeared, being replaced by one marked especially by much more profuse growth of beard. In Asia Minor Mongoloid traits are still to be seen among the lower orders, but the upper classes of the Ottoman Turks show absolutely none, having become merged racially with the primitive inhabitants of Western Asia settled there before the coming of either Aryans or Semites. In Russia the mixture is so complete that speech is absolutely no criterion of race. Dr. Oberhummer has enjoyed unusual opportunities of ethnological study among the Russian prisoners in the camps in Germany and Austria, where he has been able to make valuable observations of the most diverse ethnic elements.

Geographers and the Study of Rivers.

As an object-lesson on the differing points of view to be occupied by the geographer and geologist, Miss Newbigin has an excellent study of the "Geographical Treatment of Rivers" in the February number (1916) of the *Scottish Geographical Magazine*. Some caution is no doubt needed against the tendency to carry to extremes the study of the physical history of river development while neglecting the application of the facts to human life. Some may, however, be disinclined to follow her quite as far as she goes towards the other extreme of denying to the geographer any interest in the physical history of present surface features as such, for this would rule out of his field much of the modern work in such branches as limnology, glaciology, or oceanography, and impose a definition of geography quite alien to the primary sense of the word. Whatever be his ultimate destination, the intelligent student may surely pay some attention to objects that meet his view on the way. For the application of the facts of physical geography to human affairs, special standpoints are necessarily called for, and Miss Newbigin's suggestive sketch of the river from the human side shows clearly what some of these should be. She dwells on the importance of rivers as natural lines of penetration from the earlier-settled coast to the interior (from this point of view the reversal of the current practice of describing them in the source-to-sea direction is advocated with some force); as links between regions of different characteristics, adapted for trade with each other; and as frequently forming ways of approach by easy passes over the divide at their head to other and possibly more richly endowed regions beyond. In the development of communications different parts of the river's course or the varying forms of its valley have an important influence, and the considerations to be insisted on are, Miss Newbigin holds, quite different from those which appeal to the geologist, with his mind set on the erosive processes (chiefly active in the upper region) by which the valleys have been formed. Thus for geographical purposes the geologist's distinction between the plain and valley track is insufficient, for important differences exist between the upper and lower portions of the plain track. In the lowest part of its course the river is rather an obstacle than a help to communication, and the main routes either cross it at right angles or at best only follow its general direction, whereas higher up they may hug it closely. The distinction between **V**-shaped and **U**-shaped valleys also needs more emphasis in its effect on communications than is generally given to it. Miss Newbigin ends with a plea for

a clearer understanding of what should be the scope and aim of "physical geography," apparently holding that in its study its ultimate application to the human side should be kept in view throughout. Does not the subject, however, thus cease to be *physical* geography? Surely the very name implies a point of view closely related to that of the geologist, and the question at issue would seem to be whether or not physical geography pertains to the province of the modern geographer at all.

OBITUARY.

Sir Colin Scott Moncrieff.

IN Colonel Sir Colin Scott Moncrieff, K.C.S.I., K.C.M.G., R.E., whose death occurred on April 6 at the ripe age of eighty, the Society has lost another old and valued supporter, who had served usefully on its Council for a number of years. Sir Colin's public services were chiefly in the field of engineering works in the great Dependencies of the Empire, especially works concerned with irrigation, on which he enjoyed a well-deserved reputation as one of the foremost authorities. The sixth son of Robert Scott Moncrieff, of Fossaway, Kinross, he was born in 1836, and after receiving his education at Edinburgh Academy and the East India Company's Military College at Addiscombe joined the Bengal Engineers in 1856. For his services during the Mutiny he received the medal, and afterwards did good work in the Irrigation Department of the North-Western Provinces, and as Chief Engineer in Burma. He was transferred to Egypt, the scene of his most important work in connection with irrigation, in 1883, holding the post of Under-Secretary for Public Works at Cairo from that date till 1892. During this time he was responsible for the successful carrying through of the great engineering work of the new Nile Barrage, one of the most important preliminary steps in the modern development of irrigation in Egypt on improved lines. Leaving Egypt in 1902 he was for ten years Under-Secretary for Scotland, and ably presided over the deliberations of the Indian Irrigation Commission from 1901 to 1903. He had joined this Society in 1880, becoming a member of its Council in 1902, and Vice-President in 1907. His personal charm had endeared him to many friends, by whom his loss will be severely felt.

MEETINGS: ROYAL GEOGRAPHICAL SOCIETY: SESSION 1915-1916.

Twelfth Evening Meeting, 8 May 1916.—The President in the Chair.

ELECTIONS.—William James Heney; John T. Hilditch; Commander Ernest Mardon, R.N.V.R.; Lieut.-Colonel Roderick George Macpherson; E. Norton.

PAPER: Travels in Ecuador. Jordan H. Stabler.

Seventh Afternoon Meeting, 18 May 1916.—The President in the Chair.

PAPER: Notes on the Possibility of ascending the Loftier Himalaya. Dr. A. M. Kellas.

GEOGRAPHICAL LITERATURE: ADDITIONS TO THE LIBRARY.

Edward Heawood, Librarian, R.G.S.

For list of abbreviations see January number.

EUROPE.

Albania. *B.R.S.G.* (*Rome*), Ser. V. 5 (1916) : 5–27, 82–100. **Baldacci.**

L'Albania. By Antonio Baldacci.

Austria—Trentino and Tirol. **Lucchi.**

Minist. Affari Esteri : Direz. Gen. Affari Commerc., Anno 1915, No. 16.

Trentino e Tirolo (Aprile 1914). By Guido de Lucchi. Rome, 1915. Size 9 × 6, pp. 81. *Price L.* 0.65.

Carpathians—Glaciology. **Sawicki.**

Atti X. Congr. Int. G., Rome, 1913 (1915) : 1228–1234.

Die bisherigen Ergebnisse und offenen Fragen der Glazialforschung in den Karpathen. By L. Sawicki.

Eastern Europe—Slavs. ——.

The Southern Slav Library. 1. The Southern Slav programme (pp. 30). 2. Land and people (pp. 64). 3. A sketch of Southern Slav history (pp. 32). 4. Southern Slav culture (pp. 24). Published on behalf of the Jugoslav Committee in London. Nisbet & Co., 1915–1916. Size 7½ × 5. *Maps. Price 3d. each. Presented.*

Europe—Ethnology. *Ymer* 34 (1915) : 330–350. **Backman.**

Den europeiska rasfrågan ur antropologiska och sociala synpunkter. Af Gaston Backman.

Europe—Historical. *Ts. K. Ned. Aardr. Gen.*, 2 Ser., 33 (1916) : 30–56. **Keuning.**

Het oudste bericht over de Westkust van Europa. Door J. Keuning.

Europe—Political. **Masaryk.**

The problem of small nations in the European crisis. By Thomas G. Masaryk. (Council for Study of International Relations, Foreign Series, No. 2.) London, [1916]. Size 8½ × 5½, pp. 32. *Price 3d.*

Germany—Schleswig—Economic. *Z. Ges. E. Berlin* (1915) : 545–558. **Mager.**

Bericht über kulturgeographische Arbeiten im Herzogtum Schleswig. Von F. Mager.

Hungary—Names. **Czirbusz.**

Atti X. Congr. Int. G., Rome, 1913 (1915) : 1532–1548.

Das geographische Element in der Namenkunde von Ungarn. By G. Czirbusz.

Hungary—Slavonia—Hydrography. **Kramberger.**

Atti X. Congr. Int. G., Rome, 1913 (1915) : 1211–1215.

Die Hydrographie der Loessplateaus Slavoniens. By K. Gorjanovic Kramberger.

Hungary—Transylvania. **Veress.**

Atti X. Congr. Int. G., Rome, 1913 (1915) : 1346–1350.

La descrizione della Transilvania di Antonio Possevino della Compagna di Gesù. By A. Veress.

This important work, written in 1584, has only lately been printed for the first time under the care of the writer of the above note.

Iceland—Volcanoes. **Thoroddsen.**

Atti X. Congr. Int. G., Rome, 1913 (1915) : 1180–1187.

Einige Bemerkungen über isländische Vulkane. By T. Thoroddsen.

Italy—Apennines—Lakes. *Riv. G. Italiana* 22 (1915) : 377–398. **Anfossi.**

Notizie su alcuni laghi dell' Appennino Parmense. By G. Anfossi. *Sketch-map and Illustrations.*

Italy—Basilicata—Landslips. *La G.* (*Novara*) 3 (1915) : 319–329. **Grazia.**

Frane recenti in Basilicata. By Paolo de Grazia. *Illustrations.*

Italy—Geography. *Atti X. Congr. Int. G., Rome*, 1913 (1915) : 393–406. **Mori.**

Sul contributo portato dall' Istituto Geografico Militare ai progressi della geografia dell' Italia e delle sue colonie. By A. Mori.

Italy—Hydrography. **Marchini.**
Atti X. Congr. Int. G., Rome, 1913 (1915): 423–454.
Il contributo della Marina italiana ai lavori idrografici e l'opera del R. Istituto Idrografico. By D. Marchini.

Italy—Lipari Islands. *Esplorazione Com.* **30** (1915): 365–377. **Zappulla.**
Le Eolie. By Camilla Natalia Zappulla.

Italy—Physical Geography. **Palazzo.**
Atti X. Congr. Int. G., Rome, 1913 (1915): 415–422.
L'attività spiegata dal R. Ufficio Centrale Meteorologico e Geodinamico italiano nel campo della geografia fisica. By L. Palazzo.

Italy—Po. ——
Reale Commissione per lo studio del regime idraulico del Po. Ufficio Idrografico del Po, Parma. Fiume Po. Idrometro della Becca. Effemeridi dal 1851 al 1912. Parma, 1915. Size 13½ × 9½, pp. 13, *with many pages of Tables and Charts.*
Of great importance for the hydrological *régime* of the Po. Besides the daily gauge-readings there are tables showing maxima and minima, the days during which each stage was maintained, and the dates and courses of the principal floods (see note, *supra*, p. 475).

Italy—Venetia—Meterology. ——
R. Magistrato alle Acque, Ufficio Idrografico, Pubb. N. 64 (1915): pp. 24.
Gli osservatori meteorologici della rete di 1° ordine dell' Ufficio Idrografico. *Illustrations.*

Italy—Venetia—Mincio. ——
R. Magistrato alle Acque, Ufficio Idrografico, Pubb. N. 52 (1915): pp. 9.
Prima serie di misure di portata sul Mincio. *Charts and Illustrations.*

Lapland. *Atti X. Congr. Int. G., Rome*, 1913 (1915): 1099–1124. **Parmentier.**
Un pays neuf: la Laponie. By G. Parmentier.

North Sea—Winds and Viking voyages. **Mohn.**
Skrifter Videnskappselsk. Kristiania, I. Mat.-Naturv. Klasse, 1914 (1915): No. 3, pp. 15.
Vindene i den nordlige Del av Nordsjøen og Vikingetogene. Av H. Mohn. *Diagrams.*
The author works out the prevailing winds for each month along each of the main routes between northern Scotland, south Norway, and Denmark; showing how frequently fair winds are to be expected for the voyages in either direction.

Norway—Lofoten Isles—Vegetation. **Resvoll-Holmsen.**
Skrifter Videnskappselsk. Kristiania, I. Mat.-Naturv. Klasse, 1914 (1915): No. 7, pp. 75.
Statistike vegetationsundersøgelser fra Foldalsfjeldene. Av Hanna Resvoll-Holmsen. *Map and Illustrations.*

Norway—Nordland. **Dahl.**
Skrifter Videnskappselsk. Kristiania, I. Mat.-Naturv. Klasse, 1914 (1915): No. 4, pp. 185.
Botaniske undersøkelse i Helgeland, II. Med et tillæg: De Sorbo arranensi Hedl. et affinibus homozygoticis Norvegiæ, Auctore T. Hedlund. Av Ove Dahl. *Illustrations.*

United Kingdom—Kent. *P. Geologists' Ass.* **26** (1915): 342–347. **Leach.**
Geological and Geographical notes on Well Hill, Kent. By Arthur L. Leach. *Illustrations.*

Western Europe—Geological history. **Anderson.**
Atti X. Congr. Int. G., Rome, 1913 (1915): 1351–1358.
The former connection between Connaught (Galway) and Europe with (*sic*) an Atlantis Continent. By R. J. Anderson. *Maps.*

ASIA.

Asia—Survey. **Survey of India.**
Records of the Survey of India. Vol. **6**. Completion of the link connecting the triangulations of India and Russia, 1913. Vol. **7**. Annual reports of parties and offices 1913–14. Prepared under the direction of Colonel Sir S. G. Burrard. Calcutta: 1914 and 1916. Size 13½ × 8½, pp. 122, 180. *Maps and Illustrations. Presented.*
See account of the operations in vol. **43**, p. 664.

Himalayas—Glaciers and Mountaineering. **Workman.**
Alpine J. 29 (1915): 284–300.
The mountaineering aspect of Himalayan glaciers. By William Hunter Workman. *Illustrations.*

India. **Matthai.**
Village government in British India. By John Matthai. With a preface by Sidney Webb. London: T. Fisher Unwin, 1915. Size 8¼ × 5½, pp. xviii. and 212. *Price* 4*s.* 6*d. net. Presented.*

India—Rajputana. *J. Manchester G.S.* 30 (1915): 105–124. **Mellor.**
The home of the Rajputs. By E. W. Mellor. *Illustrations.*

Indo-China—Historical. **Gerini.**
Atti X. Congr. Int. G., Rome, 1913 (1915): 1410–1414.
I viaggi di G. M. Leria nell' Indo-cina (1639–1650). By G. E. Gerini. *Map.*

Japan—Early Cartography. **Nachod.**
Atti X. Congr. Int. G., Rome, 1913 (1915): 1359–1384.
Die älteste abendländische Manuskript-Spezialkarte von Japan von Fernão Vaz Dourado, 1568. By O. Nachod. *Facsimile Maps.*

Malay Archipelago—Borneo. *Sarawak Museum J.* 2 (1915): 197–266. **Moulton.**
The butterflies of Borneo, with notes on their geographical distribution, and keys for identification. By J. C. Moulton.

Malay Archipelago—Borneo. **Piscicelli.**
B.R.S.G., Rome, Ser. V. 4 (1915): 1119–1140.
A Borneo. By Maurizio Piscicelli. *Illustrations.*

Malay Archipelago—Celebes. **Piscicelli.**
B.R.S.G., Rome, Ser. V. 4 (1915): 1251–1276.
A Celebes. By Maurizio Piscicelli. *Illustrations.*

Malay Archipelago—Moluccas. **Brouwer.**
Ts. Kon. Nederl. Aardr. Gen., 2 ser. 32 (1915): 825–830.
Reisbericht No. II. omtrent geologische verkenningstochten op verschillende eilanden der Molukken. Door H. A. Brouwer.

Russia—Areas. *Atti X. Congr. Int. G., Rome,* 1913 (1915): 642–651. **Schokalsky.**
Le comparaison des mesures de superficie de l'Asie Russe et de ses bassins. By J. de Schokalsky.

Russia—Uralsk—Petroleum. *J.R.S. Arts* 64 (1916): 158–167. **Holiday.**
The Uralsk Province and its oilfields. By F. A. Holiday.

Turkey—Ancient Castles. *Z. Ges. Erdkunde Berlin,* 1915 (1915): 576–580. **Frech.**
Die armenischen Burgen. Von F. Frech. *Illustrations.*
The writer studied the early Armenian castles of Cilicia with a view to throwing light on the liability or otherwise of the region to earthquakes, but it is rather the general interest of the castles that is here discussed.

Turkey—Syria—Damascus. **Newton.**
Palestine Explor. Fund, Quart. Statem. 48 (1916): 33–37.
Notes on Damascus. By F. G. Newton. *Illustrations.*

AFRICA.

Italian Somaliland—Webi Shebeli. **Mazzoni.**
Atti X. Congr. Int. G., Rome, 1913 (1915): 1235–1244.
L'Uebi Scebeli. By E. A. Mazzoni.

Lybia—Phytogeography. **Béguinot.**
Atti X. Congr. Int. G., Rome, 1913 (1915): 979–988.
Per uno studio dei tipi biologici per la geografia botanica della Libia. By A. Béguinot.

Morocco—Ceuta. **Du Bocage.**
Atti X. Congr. Int. G., Rome, 1913 (1915): 1309–1328.
Etude préliminaire de la prise de Ceuta par les Portugais (le 21 août 1415). By C. du Bocage.

Morocco—Taza. **Campardou and André.**
Renseign. Col. (*Afrique Franç.*) 1915 : 149–160.
Notes historiques sur Taza. By J. M. L. E. Campardou and P. J. D. André. *Illustrations.*

North Africa—Arab terminology. **Campani.**
La G., Riv. Propaganda G. 3 (1915) : 337–347.
La terminologia geografica degli Arabi con speciale riguardo alla toponomastica della Libia. By Romeo Campani.

Portuguese East Africa—Geology. **Wray.**
Observations sur la géologie du district de Moçambique. (Extrait du tome XI. des *Communicações do Serviço Geológico de Portugal.*) By D. A. Wray. Lisbon, 1915. Size 10 × 6½, pp. 16. *Map.*
Geological results of the expedition described in the *Journal* in 1913 (vol. 42, p. 152).

South Central Africa—Travel. **Goold-Adams.**
South Central Africa. A narrative of personal travel and experiences. An address delivered to the Royal Geographical Society of Australasia, Queensland, September 14, 1915. By Major Sir Hamilton Goold-Adams. (Reprinted from *Truth*, 19 Sept. 1915.) [Brisbane, 1915.] Size 9½ × 6, pp. 26. *Sketch-maps and Illustrations.*
The writer's experiences date back to the nineties of last century. His travels, of which little has hitherto been published, extended to the extreme head-streams of the Zambezi. The illustrations include some striking sketches of animals from the life.

NORTH AMERICA.

Alaska—Glaciology. *J. Geology* 23 (1915) : 748–756. **Capps.**
Two glacial stages in Alaska. By Stephen R. Capps. *Illustrations.*

Canada—Quebec—Copper. **Bancroft.**
Canada, Dept. Colonization, Mines and Fisheries, 1915, pp. 295.
Report on the copper deposits of the eastern townships of the Province of Quebec. By J. Austen Bancroft. *Map and Illustrations.*

Canada—Silver. *B.S.G. Québec* 9 (1915) : 323–334. **Laureys.**
Les métaux précieux du Canada. B. — L'argent. By Henri Laureys. *Illustrations.*

Canada—Yukon—White River. **Cairnes.**
Canada, Geol. Surv., Mem. 50 (1915) : pp. iv., 191, vi.
Upper White River district, Yukon. By D. D. Cairnes. *Maps and Illustrations.*

North America—Geology. **Leverett and Taylor.**
U.S. Geol. Surv., Monograph 53 (1915) : pp. 529.
The pleistocene of Indiana and Michigan and the history of the Great Lakes. By Frank Leverett and Frank B. Taylor. *Maps and Illustrations.*

North America—Glaciation. *G.Z.* 21 (1915) : 684–700. **Wolff.**
Ueber die Grossgletscher von Alaska und die diluviale Vereisung von Nordamerica. Von Wilhelm Wolff.

North America—Petroleum. **Vella.**
Minist. Affari Esteri. Direz. Gen. Affari Commerc., Anno 1915, No. 15.
La produzione del petrolio nel Nord-America in rapporto colla produzione mondiale petrolifera. Rome, 1915. Size 9 × 6, pp. 13. *Price L.*0.15.

North America—Phosphates. **Adams and Dick.**
P. Nat. A.Sc., U.S.A. 2 (1916) : 62–64.
The extension of the Montano phosphate deposits northward into Canada. By Frank D. Adams and W. J. Dick.

United States—Montana. *P. Nat. A. Sc., U.S.A.* 1 (1915) : 626–628. **Davis.**
The Mission Range, Montana. By W. M. Davis. *Illustration.*

United States—New England—Mountains. **Hayward.**
Appalachia 13 (1915) : 343–349.
The highest peak in each New England State. By Perceval Hayward. *Illustrations.*

United States—New Hampshire—Lost River. **Goldthwait.**
Science, N.S. **42** (1915) : 834–836.
The origin of Lost River and its giant potholes. By J. W. Goldthwait.

United States—Yellowstone Park. **Owen.**
Atti X. Congr. Int. G., Rome, 1913 (1915) : 1216–1227.
The Geyser basins of Yellowstone Park. By L. A. Owen.

CENTRAL AND SOUTH AMERICA.

Argentine—Archæology. *Rev. Museo de La Plata* **19** (1913) : pp. xii., 209. **Bruch.**
Exploraciones arqueólogicas en las provincias de Tucumán y Catamarca. Por Carlos Bruch. *Illustrations.*

Argentine—Littoral. **Torres and Ameghino.**
Rev. Museo de La Plata **20** (1913) : 153–167.
Informe preliminar sobre las investigaciones geológicas y antropológicas en el litoral marítimo sur de la provincia de Buenos Aires. Por Luis María Torres, con la colaboración de Carlos Ameghino. *Maps and Illustrations.*

Bolivia—Ethnology. **Posnansky.**
La lengua "Chipaya" (Carangas, Bolivia). By Arthur Posnansky. La Paz, 1915. Size 9½ × 6½, pp. 27. *Illustrations.*

Bolivia—Petroleum. *Rev. Museo de La Plata* **20** (1913) : 168–197. **Schiller.**
Contribución al conocimiento de la formación petrolifera (cretáceo) de la Bolivia del sud. Por Walter Schiller. *Maps and Illustrations.*

Brazil—Roosevelt's River. **Rózpide.**
Publicaciones de la Real Sociedad Geográfica. El río de los Aripuanas (Roosevelt, Teodoro, Castaña ó de la Duda). By R. Beltrán Rózpide. [Madrid, 1915.] Size 9½ × 6, pp. 5.
Like Sr. de Vasconcellos (cf. *Journal*, vol. **46**, p. 407), the writer shows that the Rio Aripuana figured in South American maps in the eighteenth century. Several Spanish ones are considerably earlier than that referred to by the Portuguese writer.

Brazil—Terminology. *Rev. I. Hist. e G. Brasileiro* **76** (1915) : 633–947. **Garcia.**
Diccionario de brasileirismos (peculiaridades pernambucanas). By Rodolpho Garcia.

Hawaii—Mythology. **Westervelt.**
Legends of Gods and Ghosts. (Hawaiian mythology.) Collected and translated from the Hawaiian. By W. D. Westervelt. London : Constable & Co., 1915. Size 7½ × 5, pp. x. and 264. *Illustrations. Price 7s. 6d. Presented.*

South America—Charts. ———
Oficina Hidrografica de Chile. Lista de las cartas i planos reglamentarios en los buques de la armada. 3ª edicion. Valparaiso, 1915. Size 10 × 7, pp. 23.
Includes both publications of the Chilean Hydrographic Office and the British Admiralty.

AUSTRALASIA AND PACIFIC ISLANDS.

New Zealand—Westport. **Morgan and Bartrum.**
New Zealand Geol. Surv., B. **17**, N.S. (1915) : pp. viii., 210.
The geology and mineral resources of the Buller-Mokihinui subdivision, Westport Division. By Percy Gates Morgan and John Arthur Bartrum. *Maps and Illustrations.*

Polynesia—Ethnology. *Sc. Monthly* **2** (1916) : 5–26. **Mayer.**
The men of the mid-Pacific. By Alfred Mayer.

Western Australia. **Ostenfeld.**
Skildringer af Vest-Australiens Natur, særligt dets Plantevækst. Af C. H. Ostenfeld. (Særtryk af G. Ts., B. 23.) [Copenhagen, 1915.] Size 12 × 9½, pp. 35–46, 132–148. *Maps and Illustrations.*

Western Australia—Coal. **Woodward.**
W. Australia Geol. Surv., B. **64** (1915) : No. 52, pp. 7–12.
The coal resources of Western Australia. By H. P. Woodward. *Maps.*

Western Australia—Geology. **Maitland.**

W. Australia Geol. Surv., B. 64 (1915): No. 58, pp. 79–91.

The geology of Western Australia. By A. Gibb Maitland. *Map.*

POLAR REGIONS.

Arctic Navigation. **Rudnev and Kulik.**

Contributions to the knowledge of the North Sea route between Europe and the rivers Ob and Jenissej. By D. Rudnev and N. Kulik. Petrograd, 1915. Size 11 × 7½, pp. 127. *Map.* [In Russian; English *résumé.*]

A useful outline of the history of voyages by the Kara Sea route, with full bibliography.

Greenland—Thule expedition. **Rasmussen.**

Report of the First Thule Expedition, 1912. By Knud Rasmussen. (Reprinted from *Meddelelser om Grönland*, vol. 51.) Translated by Alexander Worster. Copenhagen, 1915. Size 11 × 7, pp. 425. *Maps and Illustrations.*

Spitsbergen. *B.S. Neuchateloise G.* 24 (1915): 5–23. **Mathey-Dupraz.**

Un voyage dans l'Arctique 18 juillet—16 août 1911. Par A. Mathey-Dupraz. *Map.*

Spitsbergen—Vulcanism. **Hoel.**

Skrifter Videnskapsselsk. Kristiania, I., Mat.-Naturv. Klasse, 1914 (1915): No. 9, pp. 33.

Nouvelles observations sur le district volcanique du Spitsberg du nord. By Adolf Hoel. *Maps and Illustrations.*

PHYSICAL AND BIOLOGICAL GEOGRAPHY.

Geological Time. *P. Geologists' Ass.* 26 (1915): 289–310. **Holmes.**

Radioactivity and the measurement of geological time. By Arthur Holmes. *Illustrations.*

Geomorphology. *Atti X. Congr. Int. G., Rome*, 1913 (1915): 886–896. **Azzi.**

Sur les limites de la géomorphologie. By G. Azzi. *Illustrations.*

Geomorphology. *Atti X. Congr. Int. G., Rome*, 1913 (1915): 929–935. **Neovius.**

Ueber den Einfluss des Windes auf den bewaldeten Erdboden. By E. R. Neovius.

On the effects due not only to the uprooting of trees by gales, but to the loosening of the soil round the roots in the case of more moderate winds.

Geophysics. **Negri.**

Determination de la Profundidad de la costra terrestre. By Galdino Negri. (Publicado en la *Revista del Centro Estudiantes de Ingeniera*, Año XVI., No. 161.) Buenos Aires, 1915. Size 9½ × 6½, pp. 32. *Illustrations.*

Oceanography. **Bruce, King and Wilton.**

The temperatures, specific gravities, and salinities of the Weddell Sea and of the North and South Atlantic Ocean. By William S. Bruce, Andrew King, and David W. Wilton. (From *Trans. R. Soc. Edinb.*, vol. 51, Part 1, No. 4.) Edinburgh, 1915. Size 12½ × 9½, pp. 71–169.

Plant-ecology. *P.A. Natural Sc., Philadelphia* 67 (1915): 419–425. **Harshberger.**

The diversity of ecologic conditions and its influence on the richness of floras. By John W. Harshberger.

Terrestrial Magnetism. **Fritsche.**

Atti X. Congr. Int. G., Rome, 1913 (1915): 717–740.

Détermination des elements magnétiques pour toute la face de la terre et de leurs variations séculaires, basée sur la théorie de Gauss et les observations. By H. Fritsche.

ANTHROPOGEOGRAPHY AND HISTORICAL GEOGRAPHY.

Economic—Sugar. **Mathieson.**

Sugar: past, present, and future. Can British-grown beet fill a gap? By George Mathieson. N.D. Size 10 × 8, pp. 4.

The writer does not favour the growth of sugar-beet in this country, but looks to India for an increased supply of cane-sugar.

Historical—Early Geography. **Mustawfi and Le Strange.**

The geographical part of the Nuzhat-al-Qulūb composed by Hamd-Allāh Mustawfi of Qazwīn in 740 (1340). Edited by G. Le Strange. (Gibb Memorial Series, vol. 23.) [Persian text only.] London: Luzac & Co., 1915. Size 9½ × 6, pp. xviii. and [372]. *Price* 8*s*. *Presented.*

The first trustworthy edition of the whole text of this fourteenth-century work, evolved by careful collation of all the best MSS. It is hoped to bring out a translation and notes shortly.

Historical—Eden. **Tse Tsan Tai.**

The Creation. The real situation of Eden and the origin of the Chinese. By Tse Tsan Tai. Hongkong: Kelly & Walsh, 1914. Size 9 × 5½, pp. 42. *Portrait and Sketch-map. Presented.*

The author attempts to show that the Garden of Eden was situated in Chinese Turkestan, not in the Euphrates Valley.

Historical—Measures. *J.R.S. Arts* 64 (1915): 125–131. **Watson.**

The origin of English measures of length. By Colonel Sir Charles M. Watson.

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History of Cartography. **Oberhummer.**

Atti X. Congr. Int. G., Rome, 1913 (1915): 73–77.

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Ts. Kon. Nederl. Aardr. Gen., 2 Ser., 32 (1915): No. 6, pp. 157; No. 7, 775–824.

Nederlandsche Historisch-geographische Documenten in Spanje. Door C. Wieder. Bijlage van Hoofdstuk v.; Hoofdst. vii.–xii.

Part xii. is a general introduction to the study of Dutch cartography. A reprint of the whole series has also been received, and forms a valuable contribution to the history of geography.

History of Navigation. **Cachet and Wieder.**

De oude weg naar Indië, om de Kaap. Wandversiering in de Zalen van het Stoomschip Jan Pieterszoon Coen van de Stoomvaart-Maatschappij Nederland, naar de oorspronkelijke kaarten van Petrus Plancius en Jan Huygen van Linschoten vervaardigd door C. A. Lion Cachet. Met historische toelichting door Dr. F. C. Wieder. Amsterdam, 1915. Size 7½ × 10½, pp. 32. *Facsimiles. Price* 3*s*. 6*d*.

The old charts used in the early Dutch voyages to the East have been reproduced as wall-decorations of the saloons of the S.S. *Jan Pieterszoon Coen*. They are here given on a small scale with explanatory letterpress.

GENERAL.

Education—Text-books. **Fairgrieve.**

The New Regional Geographies. Edited by James Fairgrieve. Book I. The Americas. By Leonard Brooks. London: University of London Press, 1916. Size 7½ × 5, pp. xiv. and 236. *Sketch-maps and Illustrations. Price* 3*s*. *Presented.*

The first of three text-books supplying a geographical survey of the world and providing a complete course in geography for Secondary and High Schools.

Geographical Alphabet. **Esersky.**

Atti X. Congr. Int. G., Rome, 1913 (1915): 1515–1524.

Alphabet géographique universel. By T. Esersky.

Place-names—Chinese orthography. **Vissière.**

J. Asiatique (*Paris*) XI. Ser. 4 (1914): 651–658.

Orthographe officielle chinoise des noms de capitales étrangères. Par M. A. Vissière.

With a view to uniformity an official system of spelling the names of the principal foreign capitals has lately been laid down, and it is hoped that more may be done in the same direction.

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